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ELECTRICAL WORLD AND ENGINEER.

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OUR FRIENDS FROM ABROAD.

In larger bodies than for some years past our electrical friends from England and Italy are to visit us at the end of the present month. We note elsewhere the names of no fewer than 120 people constituting two organized parties, while there are several others who will join either at the seaboard or at St. Louis. Meantime extensive and elaborate preparations are being made for the proper entertainment of these visitors, and under the leadership of the American Institute of Electrical Engineers, committees have been constituted in some ten of the leading cities that are to be visited. In this connection one point occurs to us, viz., the desirability of as large as possible a participation personally in the various functions by members and friends of the Institute. It is true that the visitors arrive at an awkward time in the recreation season, and just on the eve of Labor Day, when everyone who can hies away for a final summer holiday. But it is necessary that the Institute should be well represented, and that all who can should be on hand to make our visitors heartily welcome and thoroughly comfortable in surroundings that to many of them will be very new and strange. We trust our readers will not regard it as an impertinence to be reminded gently of the duties and obligations of hospitality. The cordial reception given American engineers abroad, especially on official occasions, calls for recognition, and the present opportunity is an admirable one to show appreciation and to strengthen the ties of international amity by actual acquaintance, friendship and heart-to-heart intercourse.

ELECTRICAL DEVELOPMENT IN MEXICO.

Of the recent rapid electrical development in Mexico we are able to present this week an interesting example in the description of the fine power transmission plant known after the famous old city of Guanajuato, to which current is delivered by it over a distance of 100 miles at 60,000 volts. The article by Mr. Doble is full and clear, and embodies a number of points worthy of notice. As he enumerates them, the chief items are: Massive and permanent construction of headworks, canal and power house; methods of regulating and measuring the water and of collecting and disposing of the detritus carried by the water during the rainy season; large pipe line with low velocity, with no horizontal angles and but few vertical angles of long radius, riveted together, forming one continuous pipe with both ends bedded in masonry, laid in a deep trench and completely covered; no receiver, the pipe terminating in branches leading directly to the water wheel nozzles, which have 7-in. jets, the largest yet used; two-bearing type of hydro-electric unit, with two 1,125-hp water wheels mounted directly on the ends of the generating shaft and overhanging the bearings; 60-kilovolt, 101-mile transmission; specially-designed porcelain insulators, larger than any heretofore used, and 19-strand, hard-drawn copper cable; long-span steel tower line construction, not more than 12 towers being used to the mile.

This transmission plant, which is but typical of the work now being achieved in Mexico with Yankee capital, brains and apparatus, is expected to do much for the ancient treasure city that is its objective point. Many of our readers will be surprised to learn that 100 years ago Guanajuato was reputed one of the three largest cities on this Western Continent north of the Isthmus. To-day all that her mines need, it appears, to be restored to their former productiveness, is cheap and constant power. In fact, the dumps of ore refuse are enough to keep the present population busy, for under modern

methods they will well repay for reworking. That this enterprise has taken shape and growth as narrated is due in especial measure to Messrs. Curtis and Hine, men who had already made high reputations for themselves in the field of electric light and power manufacture in the United States.

Line Construction.

While other branches of the electrical arts have been very rapidly developed, it is a singular fact that the construction of the line, the part of a general system perhaps most exposed to injury, has been only slowly modified. Insulators have, of course, gone through a process of evolution in the direction of greater electrical and physical strength, but the rest of the line still bears the mark of the earlier days of the telegraph. Only recently have innovations like extra strong pins and insulators and the steel tower construction with long spans fairly come into even experimental use. The novel line material and construction planned by M. Astafieff, described elsewhere in our columns, possesses, therefore, more than a casual interest. It forms obviously not so much a generalized as a specialized method, and unless we mistake not will find its main use in dealing with certain cases of distribution in which rather heavy wires and cables have to be used. It is in large part a carefully-planned system of strain insulators intended to hold the wires in a firm metallic grip and to convert the strains on the system into clean, tensile strains. From our American standpoint, it does not look cheap, and perhaps its immediate value here lies largely in a certain suggestiveness that will not be lost upon progressive engineers. By good rights a line should be built upon the principle of the famous "one-horse shay," each part being made as strong as the rest, but the plan is not easy to put into practice. Particularly in high-voltage work, the necessary insulation strength has led to the construction of insulators very difficult adequately to support, and it strikes us that some of M. Astafieff's constructions contain very useful suggestions. At all events they are worth studying.

Alternating Current Commutator Motors.

Recent experiments with single-phase machines having series motor characteristics have appeared to show that, with respect to commutation alone, practically, are alternating-current motors inferior to the direct-current type for traction. For the purpose of improving the commutation of alternating-current motors, various methods have been proposed. Those which have given any promise of success involve a substantial change in the winding of the armature, as compared with what is considered standard practice in the case of direct-current machines. The commutator difficulties referred to are due to the reversal of field flux through the armature coils. The e.m.f. generated in each coil on account of transformer action varies according to the position of the coil in the magnetic field, being a maximum when the coil is in mechanical quadrature to the field poles, or in the position at which the brushes should be placed. With the ordinary type of armature construction, a short-circuiting by the brush of a coil in which is generated an active e.m.f., even when the armature is stationary, is inevitable. To lessen the amount of current which flows in such closed local circuit, resistances properly placed so as not to remain permanently in the armature circuit may be used.

The short-circuiting effect may be largely eliminated by using two or more interlaced armature windings, so arranged that the brush cannot span the commutator sufficiently to connect two bars of the same winding. As usually applied, this method is not satisfactory, on account of the fact that the current in each winding must be completely interrupted whenever the corresponding bar passes from contact with the brush. This results in serious sparking and a pitting of the commutator equally as disadvantageous as that caused by the short-circuiting. On page 209 of this issue will be found an article by Mr. Ralph McNeill, in which he describes a construction which, while retaining the good features of the ordinary sandwich winding, is free from the interruption of current in any single armature circuit. This fact will be appreciated if a study be made of the flow of current through the several coils. The current in each circuit from the lowering transformer to the brushes is a composite one, having one component with the frequency of the supply current and another varying in frequency with the speed of rotation; but the two circuits being wound in mechanical parallel, the reactive effect of the current of each is neutralized by that of the other. The method is interesting in showing that the commutation difficulties met with in alternating-current motors are not wholly unsurmountable.

Method for Measuring Output of Induction Motors.

An interesting development in testing induction motors is described by Mr. E. Alexanderson in this issue. When operating near synchronism, the torque exerted by an induction motor varies approximately as the slip. This proportionality, which is rendered inexact by reason of the local impedance of the primary coil and the reactance of the secondary circuit, remains fairly constant throughout the working range of well-designed motors. If, during operation, a certain change in load produces a corresponding change in slip, the observation of such changes may be used to determine the ratio between slip and torque, from which the calibration constant of the motor may be found. The method of taking observations and treating the results is fully explained by Mr. Alexanderson and should commend itself to all having such tests to make. A prominent feature of the method is the practical accuracy of the results, which accuracy can be attributed to the fact that, while many minor quantities are approximated by methods quite questionable as to theory, the major quantities are directly measured and are free from errors of determination.

It should be noted that the method is essentially one for determining torque and applies to power only when the speed is properly taken into account. The fundamental equation upon which the method is based is, in itself, subject to considerable error when the slip is large, since only when the speed is constant is the power directly proportional to the torque; the equations given consequently do not apply to motors having large secondary resistance, even when of exceptionally good design. The fact that the load losses of the induction motor have not been considered in no way affects the results. The neglect of the load losses of the direct-current generator introduces a slight error which, however, appears in both methods compared and hence is eliminated in the comparison; but the degree of accuracy of the new method is not affected thereby. It is especially worthy of note that the torque for a certain slip varies as the square of the impressed e.m.f., and it is therefore essential in applying the new method that the primary e.m.f. be kept at the proper value. Lack of balance of the e.m.f.'s of the several phases of the supply circuit will also introduce considerable error in the results, and it would seem that the method in its simplicity can rarely be depended upon for more than a rough approximation to the true value of the output. Within the limits specified, however, the method will doubtless serve a useful purpose.

On the Capacity of Mica Condensers.

An ideally perfect condenser from an electrical standpoint should have the same capacity, whether its charging period were one-thousandth of one second or one-thousand seconds. It should have no leakage whatever, and its discharge should immediately be com-

plete, with no traces of residual charge. Whatever may happen in other worlds, there is no condenser in this world which can fill these requirements completely. Air condensers, however, charge and discharge practically instantaneously, with no appreciable residual discharge. A gas does not seem to harbor polarization, but if only for that reason a gas condenser always possesses some leakage, even if only very small. Owing to the definiteness in the capacity of air condensers, these are often employed as primary standards of capacity. Air has, however, but very low inductive capacity by comparison with solid dielectrics, so that an air condenser of one microfarad is a bulky affair. Moreover, air is also electrically very brittle, by comparison with solid dielectrics, breaking under an electromotive intensity of roughly a kilovolt per millimeter, whereas many solid dielectrics will withstand 15 kilovolts per millimeter and more. Consequently, a small, portable condenser must have a thin, solid dielectric, and mica is almost universally regarded as the best substance. This convenience and portability are secured at the expense of appreciable absorption and residual charge.

In a paper by E. B. Rosa and F. W. Grover, recently read before the American Physical Society, some tests are recorded of several mica condensers in regard to the above particulars, and these records display several points of interest. It is shown that good mica condensers take an appreciable time to fill up, when charged. When the charging period was 1/360 second, the charge admitted was about 1 per cent. short. When the charging interval was increased to 0.5 second, the charge was still nearly ½ per cent. short, and at 1 second, ¼ per cent. short. The charge admitted was, however, practically the same, for all ordinary purposes, whether the charging interval was 5 seconds or 20 seconds.

The moral of the story told by the records in this particular is, therefore, that a mica condenser should be charged for at least five seconds in order to fill it up. This has generally been admitted, however, from long experience, as good practice. Moreover, it should follow that the capacity of a condenser to alternating currents would diminish slightly as the frequency increased. In regard to residual charge, the records show that the mica condensers, when charged for 10 seconds, short-circuited for 1 second, insulated for 30 seconds and finally discharged through the measuring apparatus, showed a residual discharge of ⅔ of 1 per cent. of the full charge.

The leakage resistance or insulation of good mica condensers is given as about 250,000 megohm-microfarads. The temperature coefficient of variation in capacity is indicated as being quite small, and also as being positive in some condensers and negative in others.

THE COMING INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS.

The development of the plans for the forthcoming International Electrical Congress has now sufficiently far advanced to enable forecasts to be ventured upon its scope. This will be the fifth International Electrical Congress, and it is already much the largest in numbers of adherents and in the number of co-operating bodies, as well as in the number of papers specially prepared. The last International Electrical Congress at Paris was entirely successful and counted 930 adherents. Already the adhesions to the St. Louis Congress are stated to amount to 1900. The American Institute of Electrical Engineers is taking a prominent share in co-operation with the Congress, not only through its individual members, but also as a body. Similarly, the American Physical Society has arranged to co-operate with Section A, the American Electrochemical Society with Section C and the American Electrotherapeutic Association with Section H; while several other national electrical associations, in particular the National Electric Light Association and the Association of Edison Illuminating Companies, are also arranging to co-operate in some measure with a section or sections. The United States Navy Department has also appointed a delegate.

From Canada, the Royal Society of Canada has arranged to send delegates, while from across the Atlantic delegates have been announced from the Institution of Electrical Engineers of Great Britain, the International Society of Electricians of France, the leading electrical association of Switzerland, the leading electrical association of Austria, and the Italian Electrical Association. Germany is the only European country the electrical associations of which have not yet signified their intention to take part; but it is believed that this omission may yet be filled before the Congress convenes.

As regards the Chamber of Government Delegates, which is organized independently of the main body of the Congress, as at Chicago in 1893, twenty-four countries have been invited to appoint official delegates to the chamber. Nine countries have thus far made appointments, namely, Austria, Italy, Switzerland, Norway and Sweden, Australia, India, Mexico, Brazil and the United States. France and Germany have not yet been heard from, but it is expected that England will shortly appoint. The questions likely to come exclusively before the Chamber of Delegates relate to international electrical units and matters of governmental recognition.

In response to about 350 special invitations issued by the Committee of Organization to prominent electrical workers all over the civilized world, about 160 papers have been promised, or about 20 papers to each section on the average. We understand that nearly 60 of these papers, or more than one-third, are already in course of being printed in advance, ready for distribution among the Congress members at St. Louis. It seems likely that these papers may form three large volumes of proceedings, including the discussions expected at St. Louis. There can be no doubt that, considering the way in which the papers have been bespoken, the collection should prove of great interest and value.

The real value of an international electrical congress lies in the socializing and civilizing influence of bringing together workers in the same arts and science from many countries and amalgamating the mental ideas and acquisitions from many distant sources. The Congress, we believe, enrolls nearly 400 persons outside of North America, and a very satisfactory number of foreign electricians and electrical engineers are expected to attend the sessions in St. Louis. The value to the individual member lies in the opportunity afforded to visit the World's Fair under the conditions of congenial company, with the opportunity of meeting confrères from distant lands. In addition to this, each member is entitled to receive a copy of the proceedings at the cost of their production, under conditions far more favorable to reduced expense than a regular commercial enterprise could expect to offer.

The success of the project, thus far developed, is undoubtedly due to the cordial co-operation of all the members of the Committee on Organization, including particularly the section officers, upon whom a considerable amount of duty is necessarily thrown in a task of this character. The co-operating societies have also contributed in a large measure. If, however, the final success of the Congress is in keeping with the success gained at the present stage, all connected with the Congress organization will deserve to be congratulated.

Electrical Visitors to America.

The American Institute of Electrical Engineers has issued the following list of electrical engineers coming to this country at the end of the month to participate in the International Electrical Congress:

Visiting members of the Institution of Electrical Engineers, Great Britain: R. Kaye Gray, president; Col. R. E. Crompton, C. B., past president; Prof. John Perry, past president, and two ladies; C. H. Merz, member of council; Dr. R. T. Glazebrook, member of council; Hon. R. Hammond, treasurer, and lady; A. F. T. Atchison, Francis G. Baily, G. Balfour, R. S. Ball, W. A. Barnes, D. Bates and lady, Fred. Beanland, G. Conrad Blair, John T. Connolly and lady, Prof. J. D. Cormack and lady, C. B. Crawshaw, J. R. Dick, W. Duddell, R. S. Erskine and lady, W. P. J. Fawcus and lady, Theo Fielden, J. A. Foster, W. Geipel, W. A. Harris, Charles C. Hawkins, M. Hayashi, Thomas Hesketh and lady, F. Hope-Jones, M. Jennison, F. C. Kidman, L. Lehuraux, Emil H. Liebert, G. C. Lloyd, secretary; F. M. Long, Benjamin Longbottom, R. B. Matthews, R. S. McLeod, John L. Marr, W. B. Marr, G. F. Metzger, F. O. Mills, D. K. Morris, R. W. Paul, Robert B. Perring, Godfrey Pope and lady, A. P. Pyne, G. H. C. Risch, E. M. Sawtelle, A. P. Scorer, E. K. Scott, M. W. Scott, Harding B. Simons, P. S. Sheardown, C. D. Taite, Max E. J. Tilney, J. H. Tonge, R. Tree, chief clerk; George Wilkinson, R. Ffolliott Willis and lady, E. B. Wollan, H. G. Whiting, John T. Morris; total, 74.

Visiting members of the Associazione Elettrotecnica Italiana: Edoardo Ambrosano, Prof. and Mrs. Moise Ascoli, Giovanni Barosi, Carlo Barzano, C. Vincenzo Brazzola, Carlo Caminada, Alfonzo Carelli, Nicostrato Castellini, Filippi Cavalieri, Camillo Albino Curti, Filippo Danioni, Ascanio Dumontel, Dr. William Dunn, Edoardo Egger, Prof. Gino Fano, Luigi Galimberti, Dr. Ettore Gamba, Luigi Gianetti, Gian Teodoro Giorgetti, Francesco Giudice, Prof. Guido Grasso, Emanuele Jona, Prof. Luigi Lombardi, Prof. Ferdinando Lori, Amatore Maffezzini, Gerolamo Merlini, Aurelio Monteverde, Arnaldo Odazio, Augusto Pancaldi, Antonio Pesenti, Alberto Picchi, Albert Pirelli, Luigi Pizzi, Eugerio Prandoni, Emilio Rava, Luigi Robbo, Alberto Rubini, Ulderigo Segre, Giuseppe Stramezzi, Gianfranco Tosi, Achille Venzaghi, Prof. Ugo Ancona; total, 43.

It will be seen that these two parties aggregate nearly 120. There have already been scattering arrivals, and others are expected, bringing the visitors from England and Italy up to a total of about 150. Other countries like Germany and France will also be represented, though by no means so numerously, no organized trips having been made by the electrical societies.

Growth of Westinghouse Electric.

As already announced in these pages, and with the object of carrying out extension projects that have been in contemplation for some time, the Westinghouse Electric & Manufacturing Company has offered to stockholders the remaining 50,000 shares of its treasury stock at $80 per $50 share. Holders of record on August 8 will be entitled to subscribe to the additional $2,500,000 at the rate of one share for every nine shares then held, the subscription lists to close August 15.

The balance sheet of the Westinghouse Company as of March 31 last, which was issued this week, showed a large increase in surplus. The surplus on that date was $11,882,105, as against $8,812,399 on June 30 of last year. The balance sheet follows:

Assets:	March 31, 1904.	June 30, 1903.
Working assets	$19,384,639	$20,020,558
Real estate, buildings, tools, mach'y, etc.	9,937,300	7,812,249
Stock in sub-companies	3,908,363 }	7,251,383
Securities held in investment	9,932,375 }	
Patents, etc.	5,269,511	5,565,822
Total	$48,432,188	$40,849,647

Liabilities:	March 31, 1904.	June 30, 1903.
Preferred stock	$3,998,700	$3,998,720
Assenting stock	18,494,350	14,026,800
Common stock	.....	3,650
Debenture certificates	2,679,000	.....
Special loan	2,000,000	.....
Accounts and bills payable	9,378,033	7,886,163
Accrued interest	.....	.....
Surplus	11,882,105	8,812,399
Contract and funded liabilities	.....	2,787,000
Payable on new stock	.....	3,334,933
Total	$48,432,188	$40,849,647

Development in Dynamo and Motor Manufacture.

Note was made in these pages recently of the incorporation of the Burke Electric Company, under the laws of New Jersey, with a capital of $150,000. This news implies some very interesting developments in the manufacture of dynamos and motors. The Burke Electric Company has leased the entire plant of the Keystone Electric Company, of Erie, Pa., and intends to operate it on a strictly modern basis in the manufacture of dynamos and motors. The factories are located at Erie, Pa., and enjoy exceptional shipping facilities. They are equipped with thoroughly up-to-date machinery for the manufacture of dynamos and motors from the smallest sizes up to 500-kw, and slow-speed generators for direct connection to steam engines.

It is the intention to manufacture dynamos and motors under the patents of Mr. James Burke, whose machinery has been built during the past six years in Europe by the Bergmann Electrical Works, of Berlin, Germany. Many thousands of these machines are in successful use throughout Europe. The president of the Burke Electric Company, Mr. James Burke, has been closely identified with the manufacture and development of dynamos and motors for the past fifteen years. During six years of this time he was associated with the General Electric Company and its predecessors, in the design and construction of dynamos and motors, and his work there is well known in connection with the development of modern multipolar machinery. After leaving the General Electric Company he spent three years in New York as a consulting electrical engineer and devoted a great deal of time to the application of electric motors, one of the well-known methods developed and patented by him being the "teaser system," which has had a very wide application both in this country and Europe in the driving of printing presses. Mr. Burke then went to Europe to supervise the inauguration of the manufacture of dynamos and motors under his own designs and patents at the factories of the then newly-formed company, the Bergmann Electromotoren und Dynamo Werke, at Berlin, Germany, which company later became the Bergmann Elektricitäts Werke. He was also technical director and chief engineer of that company. He has returned to this country for the purpose of entering into the manufacture of American electrical machinery, and hence the formation of the company which bears his name. He is still, however, the consulting engineer of the Bergmann Company.

The company has been fortunate also in securing the services of Mr. Gustave Faure as mechanical manager and superintendent of manufacture. Mr. Faure has enjoyed a most thorough training in this line of manufacture, and in addition is a mechanical genius of exceptional ability. He entered this field as an apprentice twenty years ago. For the past fourteen years he has been connected with the General Electric Company, six years of which were spent at Schenectady and the last eight years of which have been spent in Paris at the factory of the Thomson-Houston Company. He has filled the position there of general works manager, having entire charge of all manufacturing, and has had marked success in combining American and European practice. He resigned from the Thomson-Houston Company in order to become associated with the Burke Electric Company.

Mr. George H. Winkler is associated with the new company as electrical manager, in addition to fulfilling various duties in an engineering capacity. Mr. Winkler entered the General Electric Company's works at Schenectady fourteen years ago and went through a thorough training in electrical manufacture. He has had a varied experience in the application of electrical machinery, having spent two years as officer in the Brazilian navy, where he was specially charged with electrical matters, and also having spent two years in general electrical repair business. For the past five years he has been connected with the Bergmann Company in Berlin as first assistant engineer. Mr. Herbert B. Coho, vice-president of the Keystone Electric Company, has accepted the office of head of the selling organization. Mr. Coho is so well known in connection with the sale of electrical machinery that he needs no special introduction. Mr. Coho received his early electrical training at Schenectady, where he had a thorough groundwork in the operating of electrical machinery. This knowledge, together with a thorough business training, has added much to his success in managing the sales of dynamos and motors. The accounting department will continue under the direction of Mr. G. Irving Blake, who has been treasurer of the Keystone Electric Company for the past year.

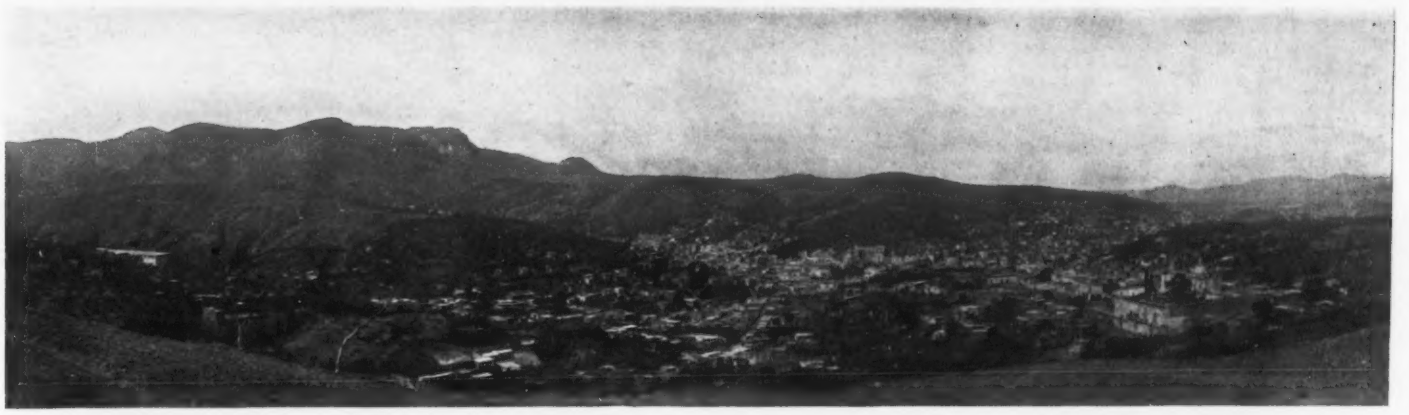


FIG. 1.—CITY OF GUANAJUATO, MEXICO, TO WHICH POWER IS TRANSMITTED 100 MILES AT 60,000 VOLTS, FOR MINING.

The Guanajuato, Mexico, Power Transmission—I.

BY ROBERT MCF. DOBLE.

THE WATER POWER.

FIG. 2.—HEAD GATES FROM DOWN STREAM SIDE.

THERE has recently been completed in the States of Michoacan and Guanajuato, Republic of Mexico, at the location shown on the accompanying sketch map, a notable hydro-electric power development and high-potential, long-distance transmission. Under a concession from the Department of Encouragement, Colonization and Industry of the Republic of Mexico, the Guanajuato Power & Electric Company constructed a canal, pipeline, power generating station, transmission line, sub-stations and distributing systems for developing and marketing the motive power of 8,000 liters (283 cu. ft.) of water per second of the Duero River.

The Guanajuato plant is a very interesting one because of its many advanced engineering features, the remarkably short time within which it was constructed and the fact that the work was completed within the estimates of cost. Some of its distinctive features are the following: Massive and permanent construction of head-works, canal and power house; methods of regulating and measuring the water and of collecting and disposing of the detritus carried by the water during the rainy season; large pipe line with low velocity, with no horizontal angles and but few vertical angles of long radius, riveted together, forming one continuous pipe with both ends bedded in masonry, laid in a deep trench and completely covered; no receiver, the pipe terminating in branches leading directly to the water wheel nozzles, which have 7-in. jets, the largest yet used; two-bearing type of hydro-electric unit, with two 1,125-hp water wheels mounted directly on the ends of the generating shaft and overhanging the bearings; 60-kilovolt, 101-mile transmission, specially designed porcelain insulators, larger than any heretofore used, and 19-strand, hard-drawn copper cable; long-span steel tower line construction, not more than 12 towers being used to the mile.

The inception and development of this enterprise are interesting. Some three or four years ago Mr. Leonard E. Curtis, who had been for a long time counsel in patent matters for the Westinghouse Electric & Manufacturing Company, and who had been obliged to leave New York and go to Colorado on account of his health, was sent to Guanajuato by clients to examine the title to certain mining properties there. In the course of this examination he became interested in the place and was impressed with the very high cost of the power used for mining operations. Being familiar with modern developments in long-distance electrical transmission, it occurred to him that the conditions there were exceedingly favorable for the introduction of electric power if a suitable water power could be found within working distance. He employed a young American, whom he found there, to search for a water power, giving him a radius of 100 miles from Guanajuato to work in. The water power which has since been developed was found and an option obtained on it during the following year. In the meantime Mr. Henry Hine, under whose management the Stanley Electric Manufacturing Company had been built up, and who had resigned his position in that company when the ownership of it changed hands, had joined Mr. Curtis in Colorado,

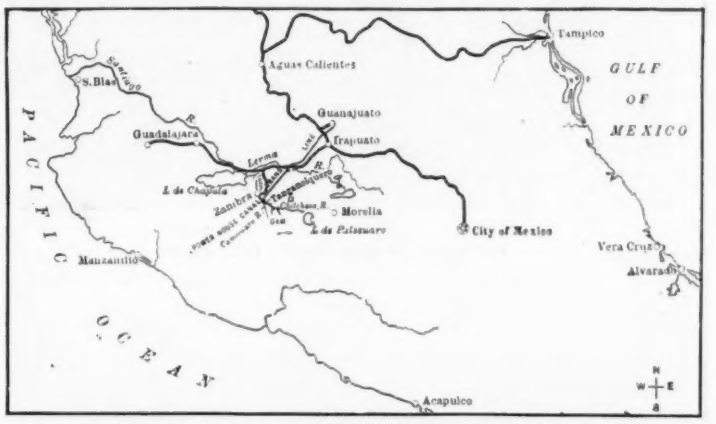


FIG. 3.—MAP OF GUANAJUATO POWER TRANSMISSION.

and the two had taken up the installation of power transmission plants together. After making a preliminary examination, they presented the matter to prominent capitalists in New York and Boston, who subscribed quickly the necessary capital, subject to an engineering examination. This examination was made by Mr. Robert McF. Doble, of San Francisco; Mr. H. H. Filley, of Kansas City, and Mr. Charles T. Main, of Boston. Their report was favorable, and the company was organized and proceeded with the construction work. Mr. Filley was employed as chief engineer of the company, Mr. Doble as consulting engineer, and Mr. Norman Rowe, formerly with the Westinghouse Company, was put in charge of the construction work

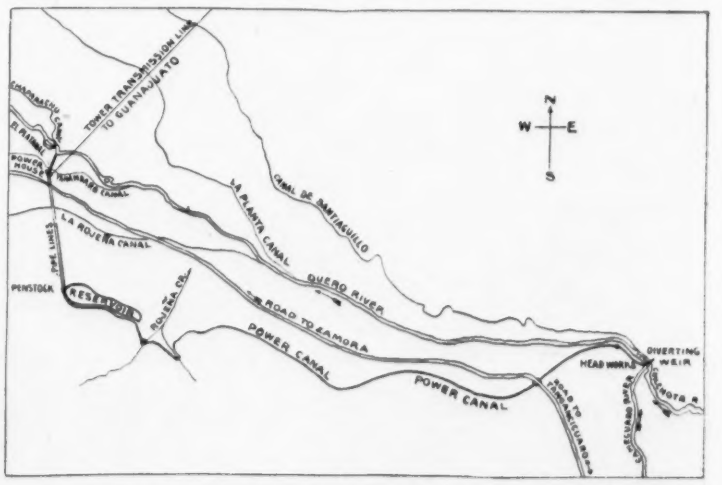
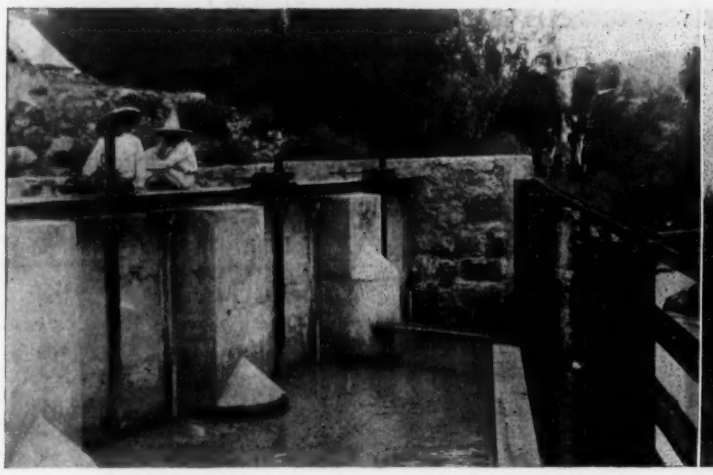


FIG. 4.—MAP SHOWING LOCATION OF HEAD WORKS, CANAL AND PIPE LINE.

at Guanajuato, where he now has charge of the plant as general superintendent.

The designs and specifications were prepared in San Francisco. The iron work for the canal and the massive steel pipeline were

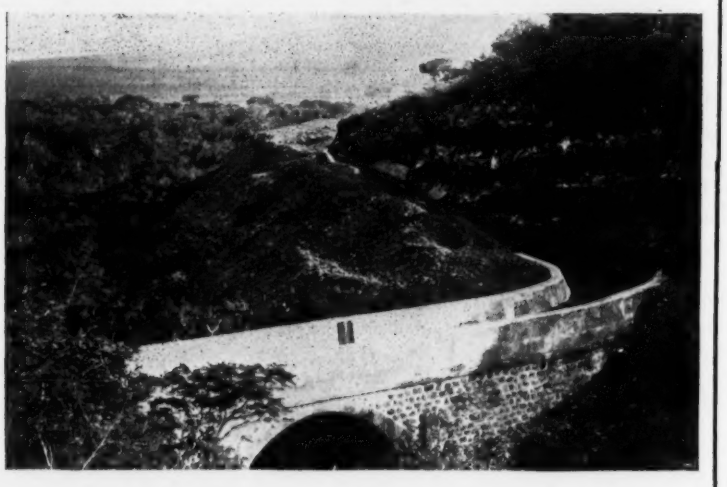
VIEWS ALONG THE POWER CANAL.



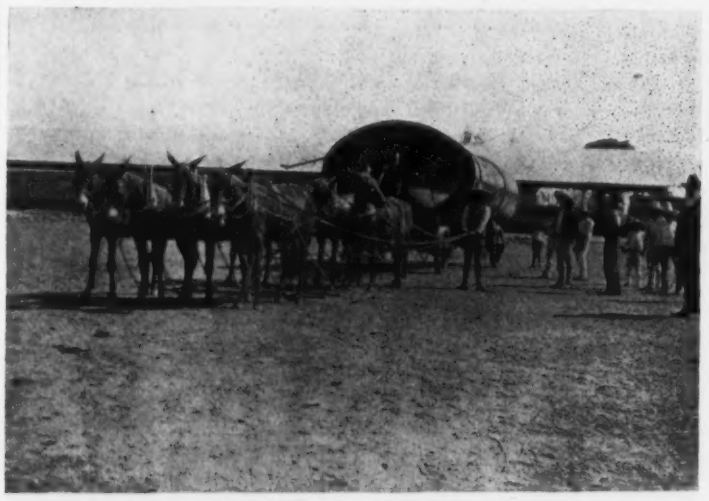
HEAD GATES AND INSIDE OF FENDER.

HEAD WORKS FROM UP STREAM, SHOWING HEAVY STEEL FENDER.

SUBMERGED WEIR AND SETTLING BASIN IN USE.



MASSIVE MASONRY AQUEDUCT.



TRANSPORTING OVAL SECTION OF PIPE.

PLACING OVAL SECTIONS OF PIPE.

FIGS. 5 TO 13.—HYDRAULIC WORK ON THE GUANAJUATO TRANSMISSION.

ordered from Messrs. Joseph T. Ryerson & Son, of Chicago. The plates for the pipeline were made in Germany, transported by sea to New Orleans, up the Mississippi River and by rail to Cudahy, Wis., and shaped and riveted in the new and finely equipped shops of the Holthoff Machinery Company there. The water wheels were constructed by the Pelton Water Wheel Company in Philadelphia. The electric generators and transformers were built at the factories of the General Electric Company, at Schenectady. The transmission cables were shipped from the shops of the Ansonia Brass & Copper Company, at Ansonia, Conn. The steel towers supporting the cables were manufactured by the Aermotor Company, at Chicago. The insulators were made by the Locke Insulator Manufacturing Company, at Victor, N. Y. The poles for the distributing circuits were bought in Texas, and the Portland cement for the masonry was brought in from Germany. From these various sources the materials came by sea and by land to the railway station at the quaint Mexican city of Zamora, whence they were hauled on wagons.

The water supply is taken from the Duero River, where it is formed by the confluence of the Camecuaro and Chilchota Rivers. Little is known of the watershed supplying the Duero River except that it is large and high. This portion of the State of Michoacan is a series of fertile valleys lying one above the other, very like a series of vast terraces. About ten miles to the south of the Zamora Valley and about 400 ft. higher in elevation lies the broad, beautiful and fertile

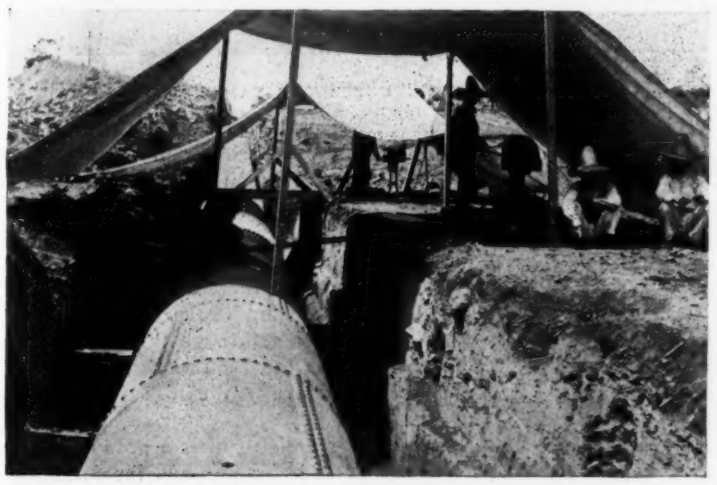


FIG. 14.—BOILERMAKERS AT WORK ON PIPELINE.

valley of Tangancicuaro, beyond which, to the south, at a greater elevation, lies the valley of Los Once Pueblos (The Eleven Villages). The Tangancicuaro Valley is nearly surrounded by mountains, which toward the south are timbered and reach an altitude of from 10,000 to 12,000 ft. Lake Patzcuaro, a large and deep lake with no known outlet, is located high up in this mountain range.

The entire area is of volcanic origin. The rain waters falling upon the high mountain lands penetrate the crevices in the basalt, percolate slowly to lower impervious strata, and then issue from the springs which abound in the valleys mentioned. The catchment area is so extensive and the distances which the water probably traverses so great that the subterranean reservoirs yield an exceedingly uniform volume from the numerous springs, which, during the dry season, furnish the entire volume of the Duero River. Such geological formation and source of supply for a river of considerable and of uniform discharge is not without a parallel, though somewhat uncommon. Similar cases may be found in the lava districts of Northern California.

The Duero River is formed by the confluence of the Camecuaro and Chilchota Rivers, which unite at the northerly edge of the Tangancicuaro Valley, just above where a low ridge of basalt crosses between the neighboring mountains. Through a break in this formation the river commences its rapid descent into the Zamora Valley, about 400 ft. below. The Chilchota branch, with its many tributaries, extends in several directions throughout the Tangancicuaro Valley and to the similar valleys terraced above it, notably Los Once Pueblos, where are located the Chilchota Springs. It has a very extensive watershed reaching to the high timbered mountains, and from it extensive irrigation is practiced. Hence, during the rainy season it becomes a rushing torrent and during the dry season the demands made upon it greatly diminish its volume. Its banks are closely lined with the sabino (or ahuehuete) trees, and from an eminence its course can be plainly traced through broad wheat fields.

The Camecuaro branch is only about a mile in length, with practically no catchment area. It is supplied by a large group of springs, the water issuing from the lava formation on the northerly side of a low hill. These picturesque springs are surrounded by a fine grove

FIG. 15.—LOWER END OF PRESSURE PIPE.

of very large sabino trees, which also closely line the banks and confine the stream within its meandering channel until it unites with the Chilchota. The Camecuaro branch has very little fall from its source to the Chilchota, and it is plainly evident that its volume is remarkably uniform throughout the year. No water is taken from it for irrigation, but at times it receives a small addition to its volume as a result of the excessive irrigation of the wheat fields lying above it with water brought through a ditch from another spring.

A number of careful current meter measurements were made and compared with figures collected from every possible source, to determine the minimum discharge of the Duero River. This resulted in the conclusion that there would never be less than a sufficient quantity of water available to warrant the construction of a generating plant of 8,000 electrical hp capacity. The possibility of increasing the low water flow by means of storage reservoirs located in the high mountains has not yet been fully investigated. There are, no doubt, many places in the large catchment area suitable for reservoirs.

Between the point where the water may be taken from the Duero River, namely, at the confluence of the Camecuaro and Chilchota branches, to the point where it must be returned to the river, namely,

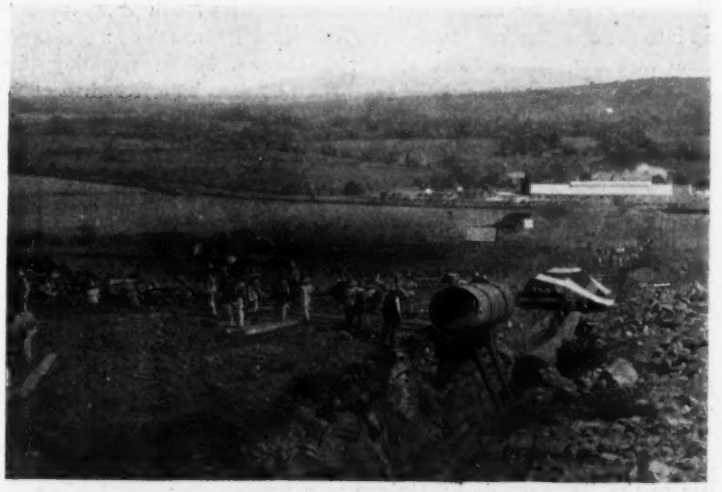


FIG. 16.—LAYING THE PRESSURE LINE.

at the Chaparacho Dam, there are three dams in the river for the purpose of diverting portions of its waters into irrigation canals for the ranches of La Rojeña, La Planta and Tamandaro.

The accompanying plot of the river, canal, pipeline, etc. (Fig. 4), shows clearly the general plan of development. The native dams in the vicinity are in strange contrast with the type of construction now to be described. The masonry diverting dam is built of volcanic rock, the interior being laid up with lime mortar and the exterior with Portland cement. It is a curved structure with a radius of 88.19

meters, the length of the crest being 80 meters. Its elevation is 1,662.40 meters above sea level. It is computed as a gravity dam for a maximum depth of 1.60 meters of water over the crest. A heavy steel fender securely braced against the masonry protects the entrance to the canal from the drift brought down by the freshets during the rainy season. Water is admitted to the canal through four head gates, each with an opening 1.25 by 2.00 meters, at a maximum velocity of about 0.80 meter per second. These head gates, run in an angle-iron frame set in the concrete, are made of wood heavily ironed, and are operated by means of a screw stem and worm gear nut, with ball bearings, which is turned by means of a hand crank operating a worm spindle with bronze thrust collars.

The canal is 6,650 meters long, is of trapezoidal section 4 meters wide on the bottom and 2.10 meters deep. The side slopes are 1:1 in soft earth, 0.5:1 in hard rock and 0.2:1 where the canal is lined with cement. Its slope is uniform 1:2,500. Its carrying capacity is 283 cu. ft. per second at a velocity of between 2 and 3 ft. per second.

To provide for accurately measuring the volume of water allowed under the concession, a "rating flume" was constructed near the head works. It is about 100 ft. of straight canal, lined with Portland cement, held in place by sheets of expanded metal. The top of the wall on the side toward the river is finished with an adjustable metal weir, which is set so as to act as a spillway when more than the proper volume of water is flowing. A short distance down stream the canal is widened and deepened, causing a reduction in the velocity of the flowing water to about one-third of the normal, so that any sand may settle to the bottom. This settling basin is provided with six valves opening from its bottom into a culvert which leads out from under the canal to the river. These valves are of new and in-

FIG. 17.—FOREBAY AND PENSTOCK IN USE.

teresting design, consisting of a circular cast-iron opening 18 in. in diameter closed by means of a conical cast-iron bell drawn point up into the opening from below and held there by means of a threaded stem and nut, which rests upon two channel beams spanning the canal. By turning the nut the cast-iron bell may be lowered to open the valve and wash out the sand which has collected at the bottom.

Immediately below the settling basin there is an adjustable submerged weir. By means of the head gates and by the adjustable lip at the rating flume, in conjunction with the submerged weir, the quantity of water flowing in the canal may be closely regulated. At the time the photographs were taken there was very little water flowing in the canal, as it was being filled for the first time to test and to furnish water for puddling the canal.

From this point the greater portion of the canal is of the character shown in the photographs. It meanders along the southerly side of the canyon under a substantial masonry arch road bridge 33 ft. wide and 16 ft. span, over a massive masonry aqueduct to a spillway (photograph No. 20), and thence to a second sand trap near the forebay. The spillway and second sand trap are located so as to make use of the Barranca de La Rojena as a waste water way leading to the Duero River.

A small storage reservoir is constructed alongside the canal at the forebay, by means of which a sufficient reserve of water is maintained to admit of cleaning the canal when required, and also to carry a very considerable peak load in excess of the normal capacity of the canal. A simple arrangement is provided for allowing the surplus water to flow into the reservoir from the canal during the hours of light load, and at the same time maintain the maximum head or pressure on the pipeline, regardless of the elevation of the water in the reservoir.

Four suitable check valve automatic gates are placed in the reservoir near its bottom, opening outward into the forebay. So long as the supply of water in the canal is equal to or in excess of the discharge through the water wheel nozzle in the power house the maximum water level is maintained in the forebay; if there is a surplus of water it overflows from the forebay into the reservoir over a suitable weir. Whenever the requirements of the water wheels are in excess of the quantity of water flowing in the canal the water

FIG. 18.—TAILRACE LOOKING UNDER THE TAMANDARO AQUEDUCT.

level in the forebay is lowered, relieving the pressure on the outside of the check valve gates, and allowing the water in the reservoir to be discharged to automatically make up the deficiency. At the entrance to the forebay the water passes over a measuring weir. On passing from the forebay to the penstock the water flows through a screen which removes all floating debris.

The massive masonry penstock shown is strengthened by iron hoops imbedded in its walls, and is interesting because of its excellent hydraulic lines. The water, after passing through the screens and through four gates similar to those at the head works, enters two ellipsoidal masonry basins which gradually diminish in diameter toward the bottom, merging into the great oval taper sections which are the heads of the pipelines. This design causes a gradual acceleration in the velocity of the water and also prevents the formation of the whirling vortex which would draw air into the pressure pipes.

Th pipeline is 2,300 ft. long, with no lateral bends. It varies in

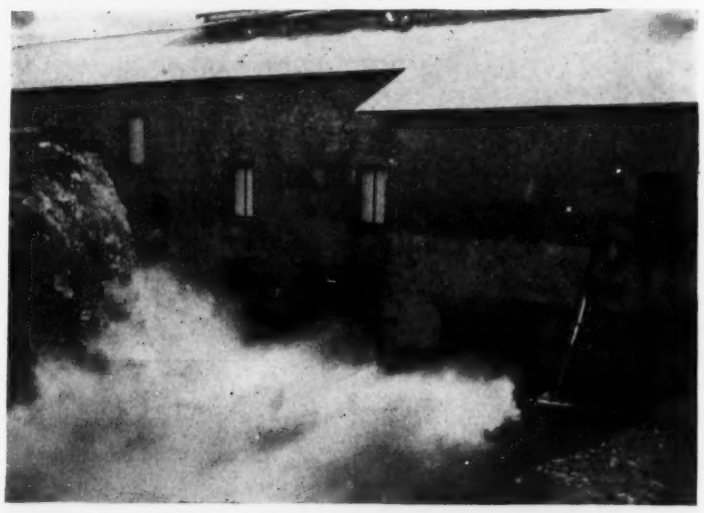


FIG. 19.—DISCHARGE INTO TAILRACE CANAL.

diameter and thickness, as shown in the following table, and was designed with a safety factor of five:

Inside diameter of pipe.	Thickness of plate.	Approximate length.
69 inches	5/16 inches	1100 feet
63 inches	3/8 inches	1000 feet
63 inches	7/16 inches	100 feet
57 inches	7/16 inches	350 feet
57 inches	1/2 inches	350 feet
57 inches	9/16 inches	200 feet
57 inches	5/8 inches	200 feet
	Total	3300 feet

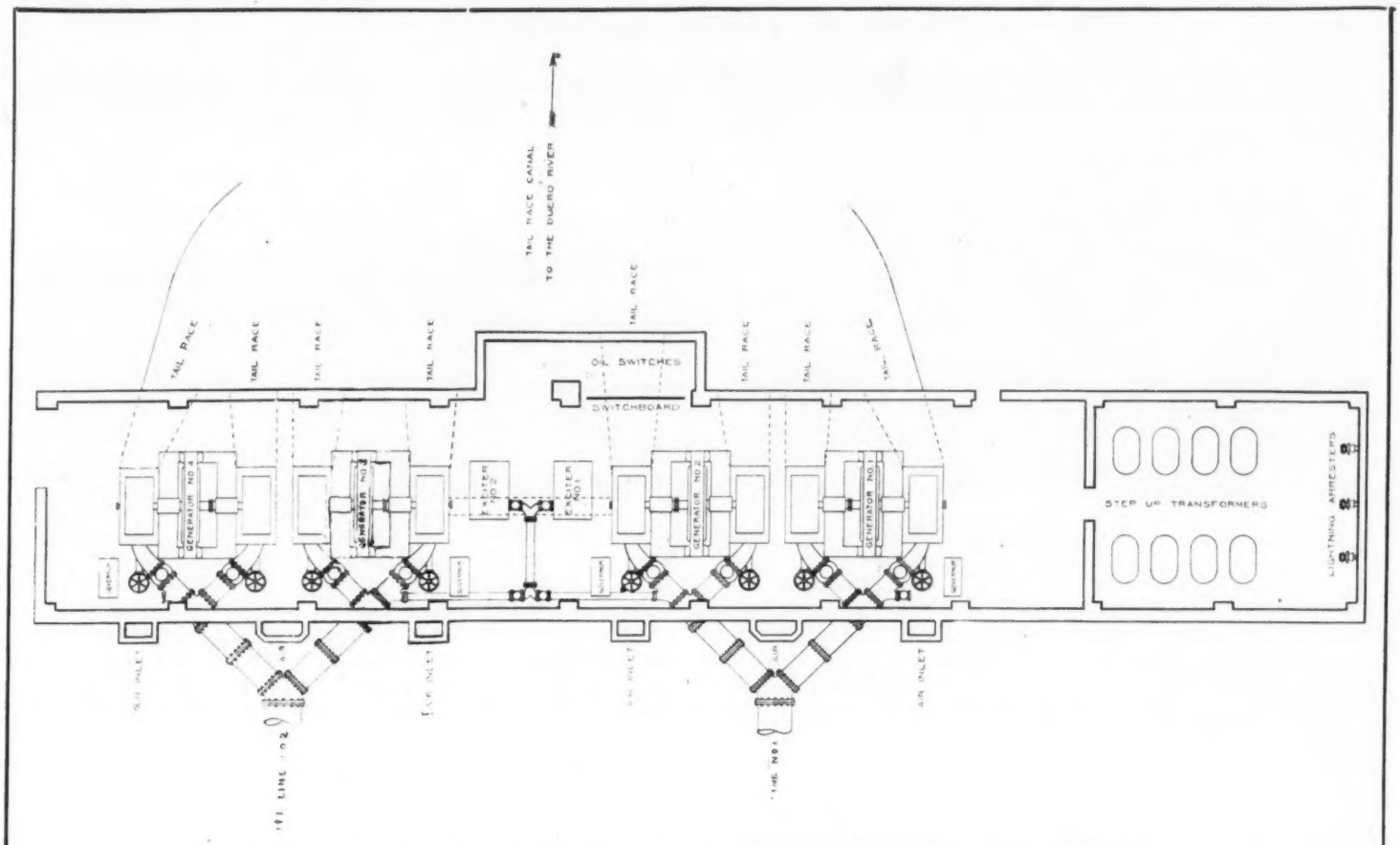


FIG. 20.—PLAN OF POWER GENERATING STATION, SHOWING DISTRIBUTION FROM PIPELINE.

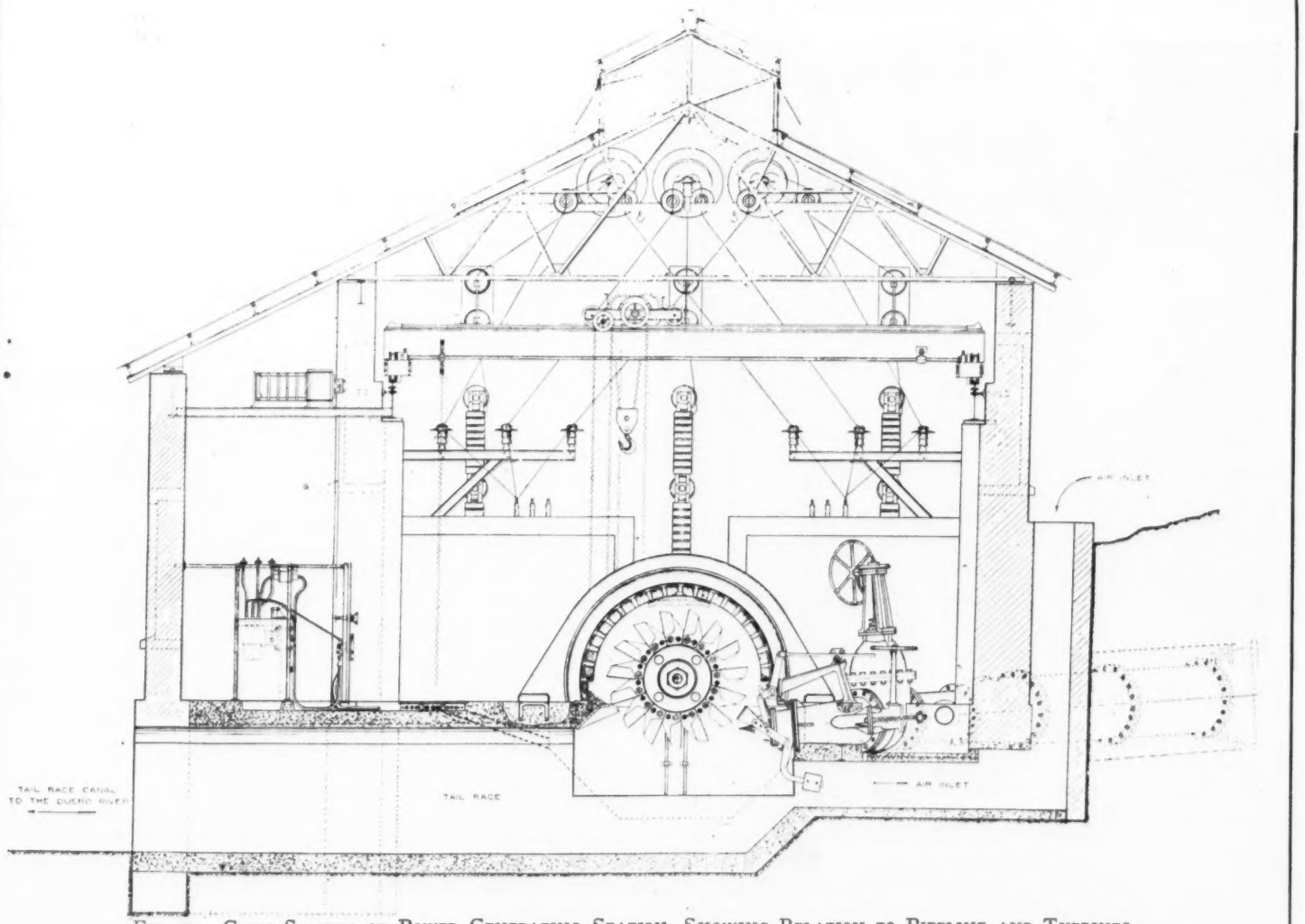


FIG. 21.—CROSS-SECTION OF POWER GENERATING STATION, SHOWING RELATION TO PIPELINE AND TURBINES.

PLAN AND CROSS-SECTION OF GUANAJUATO POWER HOUSE, WITH SPECIAL REFERENCE TO THE TURBINE PLANT.

FIG. 22.—VIEW OF POWER HOUSE FROM THE NORTHEAST.

The decrease in the diameters of the pipe section causes an acceleration in the flow of the water as it descends. This also makes possible the testing of sections for shipment. The pipe was made up from steel plates in sections 27½ ft. long and weighing from 7,000 to 10,000 pounds each. The plates were carefully selected and tested, being required to have the following characteristics: Tensile strength, 52,000 to 62,000 pounds per sq. in.; elastic limit, not less than one-half the tensile strength; elongation, 25 per cent.; 180° cold quench bend flat on itself without fracture on the outside of the bent portion. There are 480 separate plates in the pipe, each rolled tapering, the small end of one fitting inside the large end of the one next below it.

All seams were lapped, and the longitudinal seams were designed so as to have at least 70 per cent. of the strength of the plate. These

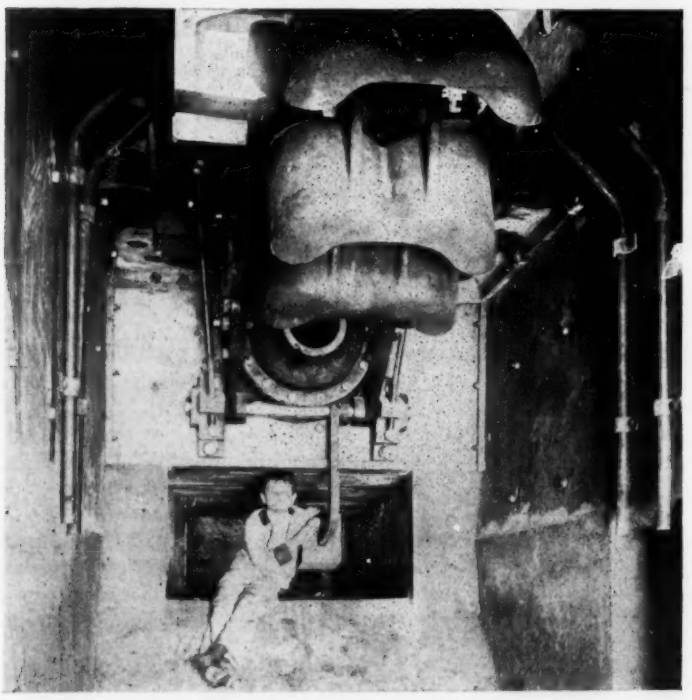


FIG. 23.—WATER WHEEL SEEN FROM UNDERNEATH, SHOWING NOZZLE.

longitudinal seams were placed so that they are on top of the pipe and alternately opposite, with the caulking edges up. The longitudinal seams are double riveted; the circular seams single riveted. All the shop riveting was done by a large hydraulic riveter. The field riveting was done by hand by a gang of expert boilermakers sent to Mexico for that purpose. Two riveters, a helper and a man at the forge to heat rivets could finish one circular seam in a day. When riveted the pipe was caulked and an extra coat of preservative paint was applied. Each section of the pipe had on top near its lower end a hole through which the hot rivets were passed from the forge to the man inside. The hole was tapped and a plug screwed in after the joint was riveted. Each section was plainly marked at the factory with letters indicating its position in the pipeline.

The common practice of laying pipes of this character on top of the ground and supporting them on piers was not followed. A deep trench was dug, the bottom of which was graded on long tangents and with slight vertical angles. The pipe was laid in this trench, beginning with the section nearest the power house and riveting on section after section, working up hill. Bell holes were dug in the bottom of the trench so that the riveters might have room to swing their hammers. The back filling of the trench was done with great care, the earth being dampened and thoroughly tamped under and around the pipe. During the early morning hours, while the pipe was cool and at its minimum length, the top covering was completed.

On August 24, 1903, the pipe was tested and so well had the work been done that not a single leak was found, although there are over 70,000 rivets. The pressure pipe terminates at the bottom of the hill in branching cast-iron pipes leading through the south wall of the power house to the nozzles. The power house, which will be treated in Section II, has masonry walls built of native volcanic rock. The roof is of galvanized iron, supported by steel roof trusses and lined with an anti-condensation lining. As shown by the photographs, it is built in an excavation extending to a considerable depth below the natural surface of the ground. This was done for economical reasons; the pipeline profile being quite flat at the lower end, where the pipe is the thickest and most expensive, it was concluded that it would be cheaper to excavate a longer length of tailrace and to dig deeper for the power house than to extend the pipeline, as each additional foot on the 47-in. pipes ⅝ in. thick would cost a considerable amount.

Electric Railways in England.

In an interesting survey of the railroad situation in England, the London *Railway News* says: "The first six months of 1904 will be memorable in railway history as the date of the conversion of the first sections of standard railway from steam to electric traction. On April 29 the Northeastern inaugurated electric working from New Bridge Street Station, Newcastle, to Benton, a distance of about five miles, this being the first completed installment of the electrification of thirty-seven miles of railway in the neighborhood of Newcastle, several other portions of which have since been opened. The whole work has now been completed, and the full service of electric trams is running. On April 5 the Lancashire & Yorkshire opened to the public an electric service between Liverpool and Southport, and there are now seventy electric trains running every day between these two points, a distance of about twenty miles. In the neighborhood of London the electrification of the Metropolitan and Metropolitan District Railways is proceeding very rapidly, and in March the former company invited a party of guests to a trial run of the first set of the new open corridor cars which have been built for the electrified service. It is hoped that electric trains will be running through from Baker Street to Harrow, and over the new line to Uxbridge, before the end of the year. In the meantime the Uxbridge line is to be opened at once with a service of steam trains. The District Company continues work on electric service over its newly opened lines from Ealing to Harrow and to Park Royal."

New System of Wire Fixing and Protecting Apparatus for Overhead Electric Light and Power Wires and Cables.

In a paper recently presented (May, 1903) to the sixth Electrochemical Section of the Russian Imperial Technical Society, M. N. K. Astafieff describes his new system of fixing overhead wires and the devices he adopts for holding the wires, coupling them together, and giving the necessary fuse protection. Among the advantages of the new system an important point is that the geometrical axis of the apparatus coincides exactly with that of the wires. Owing to this fact the apparatus is subjected only to longitudinal strains, eliminating the bending and twisting effects upon the wire, which show

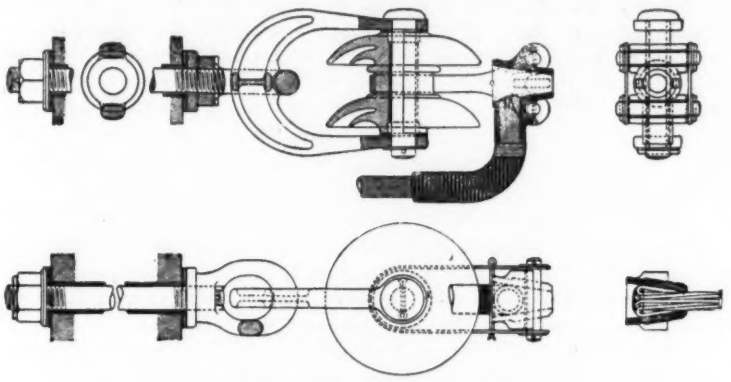


FIG. 1.—WIRE-HOLDING DEVICE.

themselves at the points where the wires are fixed, on insulators and brackets, for instance. Another point is the method of pivoting such devices, which gives them great flexibility, and allows the wires to be run at any desired angle and in any direction, including the perpendicular. As to the mechanical solidity of the devices, it is to be noted that all the metal parts which are subject to strain can be made of steel, while copper is used only for the electrical parts. In this way the devices can be made very light. The porcelain which furnishes insulation for the devices forms a non-hygroscopic material

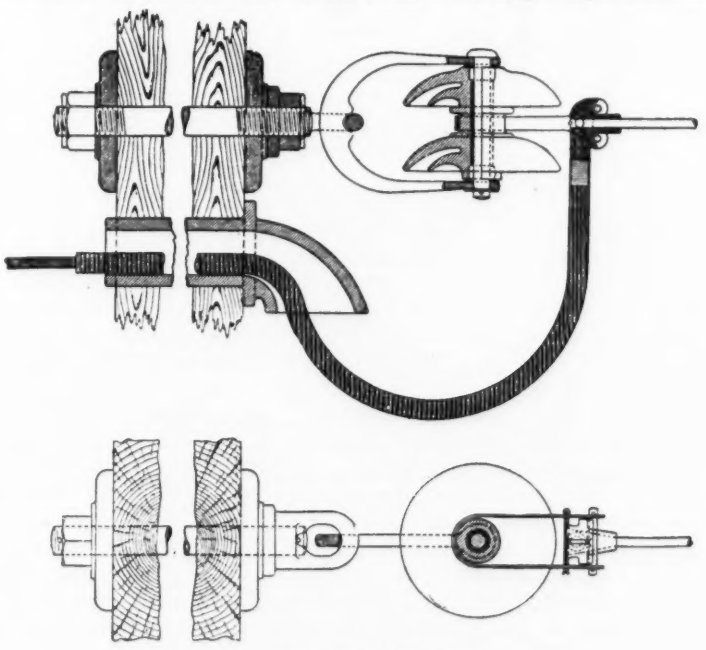


FIG. 2.—WIRE-HOLDING DEVICE.

and also stands the mechanical strain to which they are subjected. Screw joints are replaced by bolts and nuts with cotters, in order to give greater solidity and durability. The wires and cables have good connections, which are obtained by soldering in most cases. The apparatus is easily put together and fixed in place. In Figs. 1 and 2 will be observed the different forms of wire-holding devices.

The first and most important part of the fixing device is the porcelain insulators, which are of the double-bell form. Their diameter and shape depend upon the section of the wire and the tension it carries. The insulators are connected by the metallic parts on one hand to the fixed points of the apparatus, and on the other with the end of the line wire. The insulators are held in place by a cross bolt or pin, which has a spring washer on one end and a washer and cotter on the other. Around the cross pin can be placed an ebonite bushing under the porcelain, which is used in some cases to add to the insulation. The cross pin is held in a stirrup, whose dimensions and shape depend on the section of the wire. The profile of the stirrup for heavy wires sometimes takes the form shown in the figure; for smaller sizes it resembles a rectangle. To give a more regular pressure on the porcelain, the cross pin is surrounded by a bushing of soft metal alloy. The insulator has a groove in the middle and in the groove fits the rim of the wire holder, which is preferably cast of bronze.

In places where the porcelain touches the sides of the stirrup, bronze rings are also provided. The wire holder whose eye passes around the insulator has an enlargement at the outer end in the form of a double lug. Through each part of the lug passes a dowel

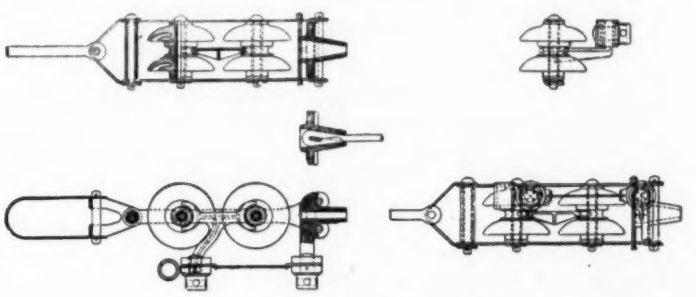


FIG. 3.—WIRE-HOLDING DEVICE.

pin, which serves to hold the copper socket carrying the end of the cable. The socket carries on each side a projection which bears against the pins. The details of this device are further explained below. The eye bolt, which holds the main stirrup against the support, can be varied in length, according to whether it is to be fixed against stone or wood. In the case of a stone wall a bar can be fixed in the wall by lead or cement. Fig. 2 shows the method of attaching to a wood support. The fixing bolt may also be two-sided

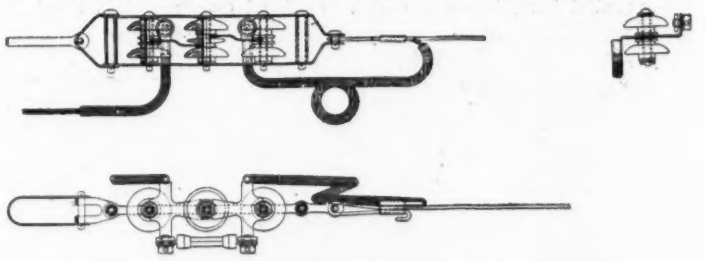


FIG. 4.—WIRE-HOLDING DEVICE.

and can thus carry a fixing device on each end, as will be noticed in Fig. 5.

The wire or cable is fixed to the device in different ways. Wires of small diameter are fixed as shown in Fig. 3. The end is bent into a loop which fits into the socket, and a pin is driven through the

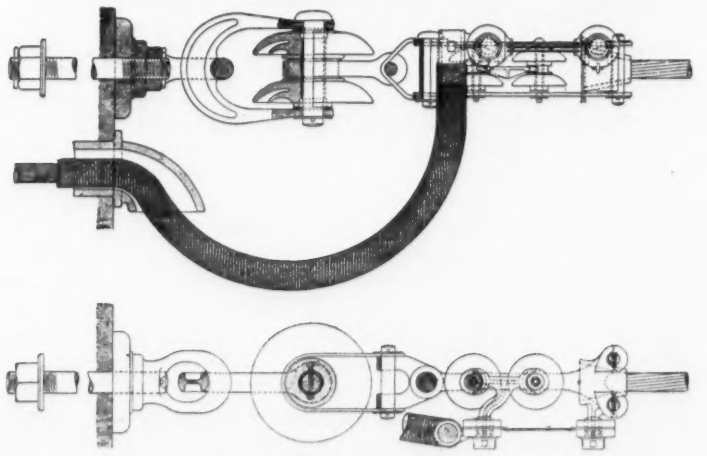


FIG. 5.—WIRE-HOLDING DEVICE.

loop. The second method of fixing a small wire is somewhat less preferable. The line wire is passed around the insulator and the

end put through a small tubular socket, which also carries a small flexible cable for the current; the whole is soldered. To fix heavy cables the method shown in Fig. 1 is used. The end of the cable is given a mushroom head, which is formed by bending down the strands around a metal ring, which has been previously put on. The head thus formed makes a tight fit in the conical socket, and is soldered into it. This method of fixing cables and wires has proved very successful both as to mechanical solidity and electrical contact. The sockets are provided with an extra lug or sleeve, which receives

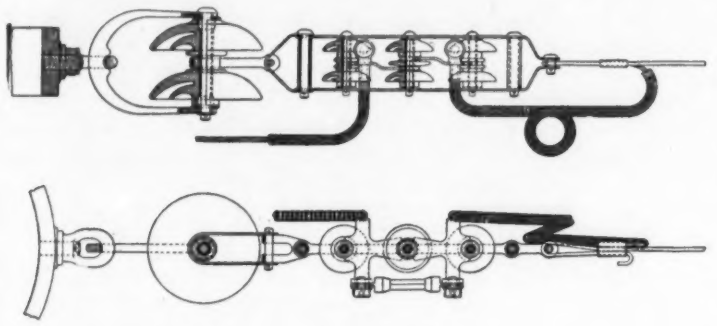


FIG. 6.—WIRE-HOLDING DEVICE.

the flexible wire or cable carrying the current. They are single or double, according to the number of cables to be carried.

The second class of fixing device is intended to be used in connection with insulators. A stirrup passes around the head of the insulator. The arms of the stirrup are separated by a cross pin and to them are fixed a second piece, which carries the cable socket somewhat as before by means of two cross pins.

One of the features of the system is the method which is employed to insert fuse wires into the circuit of the line so as to protect the machines at the station. The safety device is put in series with the line in every case where there is a branch or a change in diameter of the wire. These overhead safety appliances are of two kinds. One of these is shown in Fig. 3. The apparatus is formed of two parallel bars, between which are fixed two porcelain insulators

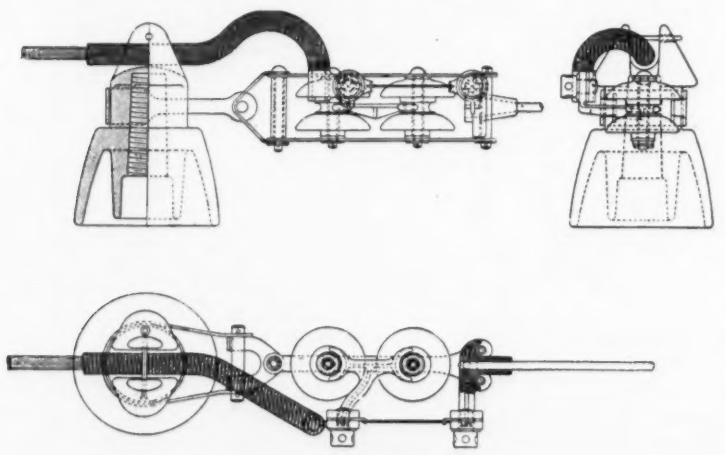
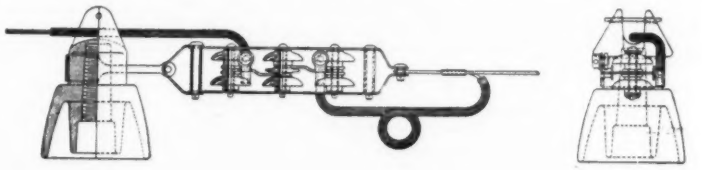


FIG. 7.—METHOD OF INSERTING FUSE.

by means of cross pins like the preceding case, with washers and cotters. Where the pins run through the porcelain they are coated with a zinc-lead alloy. Around a third and similar cross pin in the rear is placed a strap which connects the device with the fixed support. On the right-hand end is a socket for the cable, somewhat like those described above. The socket which is here used differs from the ordinary form, as it contains an arm which extends out on one side to receive the end of a silver fuse wire. The other end of the fuse is fixed to a supporting piece of special form. It has two lugs of semi-circular shape, which serve to fix it between the two insulators. The two arms which thus hold the fuse are disposed so as to project out at the side of the apparatus, so that the leading wire can connect with the fuse from the top or bottom. This wire connects with the left-hand arm by a suitable disposition.

In the case of smaller wires the fuse device takes another form, as will be observed in Fig. 4. The cable bringing the current is fixed to an arm which projects from a copper piece, fixed as before between the two left-hand insulators. A similar piece is carried between the right-hand insulators. The fuse wire, which is carried in a glass tube with copper end pieces, is bolted down between two arms which project from the copper pieces. In this type of apparatus it is easy to clean or replace the porcelain insulators, or to renew the fuse wire. Where the fixture of the above type is applied at the entrance of a building, the arrangement shown in Figs. 5 and 6 can be used to advantage. Here the safety apparatus is coupled to the fixing device of the first class, as observed. Figs. 7 and 8 show how the system is applied to an insulator mounted on a bracket. The heavy cable form is seen in Fig. 7, while for lighter wires the device in Fig. 8 is employed.

In the case of a line wire which changes its section at the point where it is supported, the fixing device can be combined with the fuse apparatus, as shown in Fig. 9. In the center is the channel bar, which serves as the support. Through it passes a double eye bolt, and on each side is placed a fixing device of the first class. The wire on the left has a large section and that on the right a smaller section. To the latter is coupled a safety device which is adapted to the current in the smaller wire. The safety device is connected with the fixing device on the left by a flexible cable. The latter is held upon a porcelain insulator, which is fixed by a lug to the eye bolt. Where a porcelain insulator forms the support the device is so arranged that a strap passes around the insulator. On one side the strap holds a link which connects it with the fixing device. To the latter is joined a safety device of the appropriate size for the current in the small wire, which comes in on the right. On the left the heavy cable is fixed in a copper socket of the above-mentioned type which is attached to the strap passing around the porcelain insulator. The safety device is joined to the cable socket by an insulated flexible cable, which is held in place by a porcelain insulator



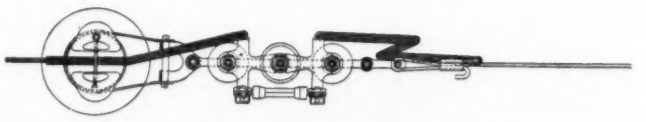


FIG. 8.—METHOD OF INSERTING FUSE.

fixed on the end of the main cross pin of the fixing device. For this purpose the cross pin is made longer.

The differences of temperature which occur in some countries have a marked influence on the conditions of the wire span; it influences the fixed points which support the wire as well as the wire itself and the amount of sag. In such cases it is sometimes advantageous to use at the supporting points a spring, which, owing to its elasticity, suppresses the above drawbacks to some extent. In the center is the channel bar support. The main bolt is lengthened out and receives a heavy spring, which works between a washer fitting upon the channel bar and an outer washer held at the end of the bolt. The length, diameter, cross-section and form of the spring to be used here depend upon the section of the wire and its length.

The fixing apparatus of the above types has another advantage. If the tension exceeds the breaking limit of the porcelain the latter, which is the weakest of the mechanical parts, will break; in such case, however, the continuity between the wires is not destroyed. As the porcelain is surrounded by a metal ring in the middle this portion is held together and does not fall down in ordinary cases. Experiments showed that with a tension of 2,000 kg. (using a 50-sq.-mm. wire in the span), in which case the porcelain breaks into small pieces, the insulation still remains about as before and the device can be left in place for several weeks, yet retaining the required insulation resistance.

This is a valuable quality of the new device, as the falling of wires from insulators occurs very often. The main reason for this lies in the difference in the height of the fixing points of the wire, and also in the production in the case of ordinary insulators of forces which tend to bend the brackets or even the whole post on which they are fixed. Another reason is the cutting of the heads

of the insulators, which comes from frost, ice, storms and other meteorological conditions. A good safety device to be used on overhead wires seems to be wanting up to the present. Such a device should have the following qualities: 1. It must not lead to any complication on the poles. 2. It must have a high insulation. 3. It should be easily reached and cleaned. 4. The fuses should have a good contact and be easily replaced.

There is no doubt that the falling of overhead light and power

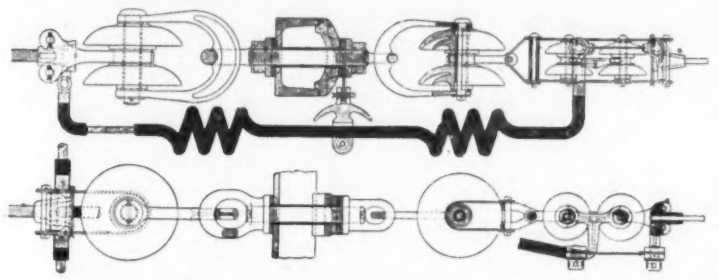


FIG. 9.—METHOD OF INSERTING FUSE.

wires is mainly due to the imperfect methods of fixing the wires, this being in most cases based on the same principle as for telegraph wires, yet the falling of the telegraph wires does not compare, as to damage done, with the falling of electric light wires.

Single-Phase Series Motor.

BY RALPH MCNEILL.

A SINGLE-PHASE motor having the general characteristics of a series-wound, direct-current motor has long been desired for railway purposes. As is well known, a series motor of the direct-current type, with commutator and with laminated magnetic circuit, will operate if fed with a single-phase current, but it has a serious drawback, which thus far has made such a motor impracticable. This is the vicious sparking caused by the short-circuited coil under each brush acting as a short-circuited secondary of a transformer, the field coils being the primary. This is sometimes called the transformer action.

It has been proposed to suppress this sparking by using a very low line frequency or by the use of resistances in the leads from the armature windings to the commutator bars, or both. With a frequency of 9 cycles per second it seems freedom from sparking can be secured without the use of resistances, but transformers for such a low frequency are large and very expensive, and on that account objectionable. With a frequency of 25 the sparking can be suppressed by resistances, but the latter become very hot after a short run, and with higher frequencies the resistances required and the consequent losses in them become so great as to make such frequencies impracticable.

Some years ago another and entirely different method for suppressing the sparking suggested itself to me, the underlying principle of which is to avoid entirely the short-circuiting of the armature coils which are under commutation, or in other words, to make it impossible for the so-called transformer action currents to flow. Several motors of moderate size were constructed and they operated on a 60-cycle current with good results, though they were somewhat crude in form.

This short-circuiting of the coils under commutation is prevented by making it impossible for the two commutator bars connected to the two ends of an armature coil to be in contact with the same brush. The method used to accomplish this result will be understood from the schematic representation of Fig. 1.

The armature has a triple, parallel winding connected to successive bars of the commutator, as shown, and is of a type of winding common with direct-current machines. It is supplied with current by two pairs of brushes, each being located within the neutral zone. These pairs of brushes are fed from the secondary of a transformer wound in two distinct parts, which are parallel and identical, but not electrically connected with each other. A dynamo is shown as a source of single-phase current, with leads to the primary of the transformer. Being a series-wound motor, the armature current also traverses the field coils, as shown.

It will be noticed that the brushes are of a particular thickness compared to the width of the commutator bars, and are so placed that as the armature revolves all three of its circuits are at all times supplied with current, and yet at no moment is an armature coil short-circuited. The current for the different armature windings shifts from one secondary coil of the transformer to the other; but at no time is any armature or transformer circuit broken. Since short-circuiting of the armature coils does not occur, sparking from that cause is eliminated, and for this reason the transformer action is avoided.

The statement made above as to the entire avoidance of transformer action, while being practically in accord with the results obtained, must be modified to include all minor effects. When the generation of e.m.f's in the individual armature circuits, on account of the alternation of the flux surrounded thereby, is very closely investigated it will be found that, at certain positions of the armature, individual brushes serve to complete a local circuit in which is generated an active e.m.f. The value of this e.m.f. depends upon the slightly displaced geometric position of the two armature windings which are combined in closed circuit. In very marked contradistinction to the effect with the ordinary single-winding armature, however, the local circuit through which the active e.m.f. must force current includes, not just a single coil, but the whole of the two armature windings thus combined, so that the current produced by such short-circuiting is practically negligible and the commutation is unaffected thereby. At the same time, as far as the motor action is concerned, the short-circuiting of the individual coils is avoided entirely, as will be seen by imagining the double secondary of the transformer in the figure to be replaced by two batteries or two generators insulated from each other. It will be noted that the current in the two secondaries of the transformer will be subject

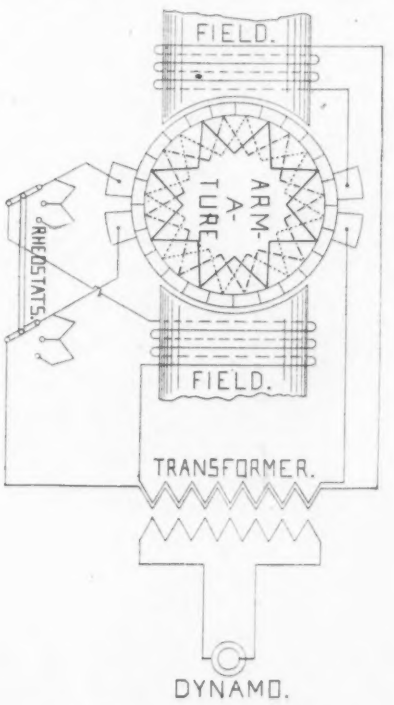


FIG. 1.—SINGLE-PHASE MOTOR.

to a pulsation having a frequency depending upon the speed of commutation. This, however, does not affect the flux or primary current of the transformer, as the variations of current in the two secondaries are equal and opposite. But this and numerous other features are beyond the scope of the present short description.

Rheostats, inductive regulators or other means for varying the voltage of current to the armature may be used for speed control. Two starting rheostats are shown, one in each secondary circuit, with a bar connecting them to insure identical and simultaneous operation of each.

With a motor of this type, with its transformer, etc., on a car, single-phase current seems to become practicable for railway purposes, permitting the distribution of power from the power house to the trolley directly, or through static transformers, and eliminating sub-stations with their rotary converters, attendance, etc. This will simplify the present system and reduce the initial cost very materially. With alternating current, electrolysis is absent, and the damage to buried water and gas mains which is occasioned by direct current may be avoided by the installation of a complete alternating-current system.

Exeter, England, New Central Station.

EXETER was one of the first English cities to go into the public supply of electricity, the original plant having been started some fifteen years ago by the Exeter Electric Lighting Company, consisting mainly of local residents. In 1896 the municipality took over the system, which had been extended from time to time; and in 1901 still further extensions were decided upon, these involving the erection of a new generating station in a more convenient position by the River Exeter.

The supply has hitherto been on the high-tension, single-phase system, with Thomson-Houston series arc lighting dynamos for the supply of the street lamps. The new plant is two-phase, the growing requirements for power, and the very probably early adoption of electric tramways, rendering a continuation of the old single-phase generating system impracticable. Two-phase working was adopted in preference to the more orthodox three-phase, as it involved the least amount of alteration to the existing mains. It is interesting to note that the change from the single to the two-phase system was effected without any interruption of the supply of current to consumers.

The buildings at present erected cover an area of about 150 sq. ft., and considerable room has been allowed for future extensions. They are divided into three bays, which form the boiler house, the engine and generator room and the offices, respectively, the economizers, boiler feed pumps, etc., being situated in annexes. The chimney is a handsome octagonal structure of brick, and is 155 ft. high, with an internal diameter of 8 ft. 6 in. The boiler house is a lofty building 102 ft. long and 55 ft. wide, the engine room being of the same length, but 10 ft. less in width. The floor is of terazzo mosaic paving to insure the utmost cleanliness, and galleries give access to the switchboard as well as to the boiler house and the various offices.

The system of handling the fuel is very complete. The coal is put into chutes which deliver it to the automatic filler of the gravity bucket coal conveyor, which is electrically driven by a Westinghouse two-phase induction motor. This conveys the fuel to a gallery under the roof, the fuel then being dropped into one or the other of a series of bunkers underneath, these bunkers having a capacity of about 13,500 cu. ft., which is equivalent to about 500 tons. The conveyor can deal with 30 tons of coal per hour. From the bunkers the coal is discharged in measured quantities into the hoppers of the chain grate mechanical stokers. The latter are also electrically driven, and besides carrying the coal into the fires, discharge the ashes and clinkers into the basement below the boilers, whence the same conveyor removes them to the ash bunker. A railway siding, at present under construction, will complete the fuel and ash-handling arrangements. The boiler house plant consists at present of three new Babcock & Wilcox boilers, each with a heating surface of 4,020 sq. ft., and fitted with superheaters. Eventually, four of the boilers in the old station, which are of the same type, will be brought over to the new station and the total capacity will then be 2,700 hp. A steam pipe ring on the boiler house wall carries the steam into the adjacent engine room, this being so arranged that any boiler or engine can be isolated if necessary.

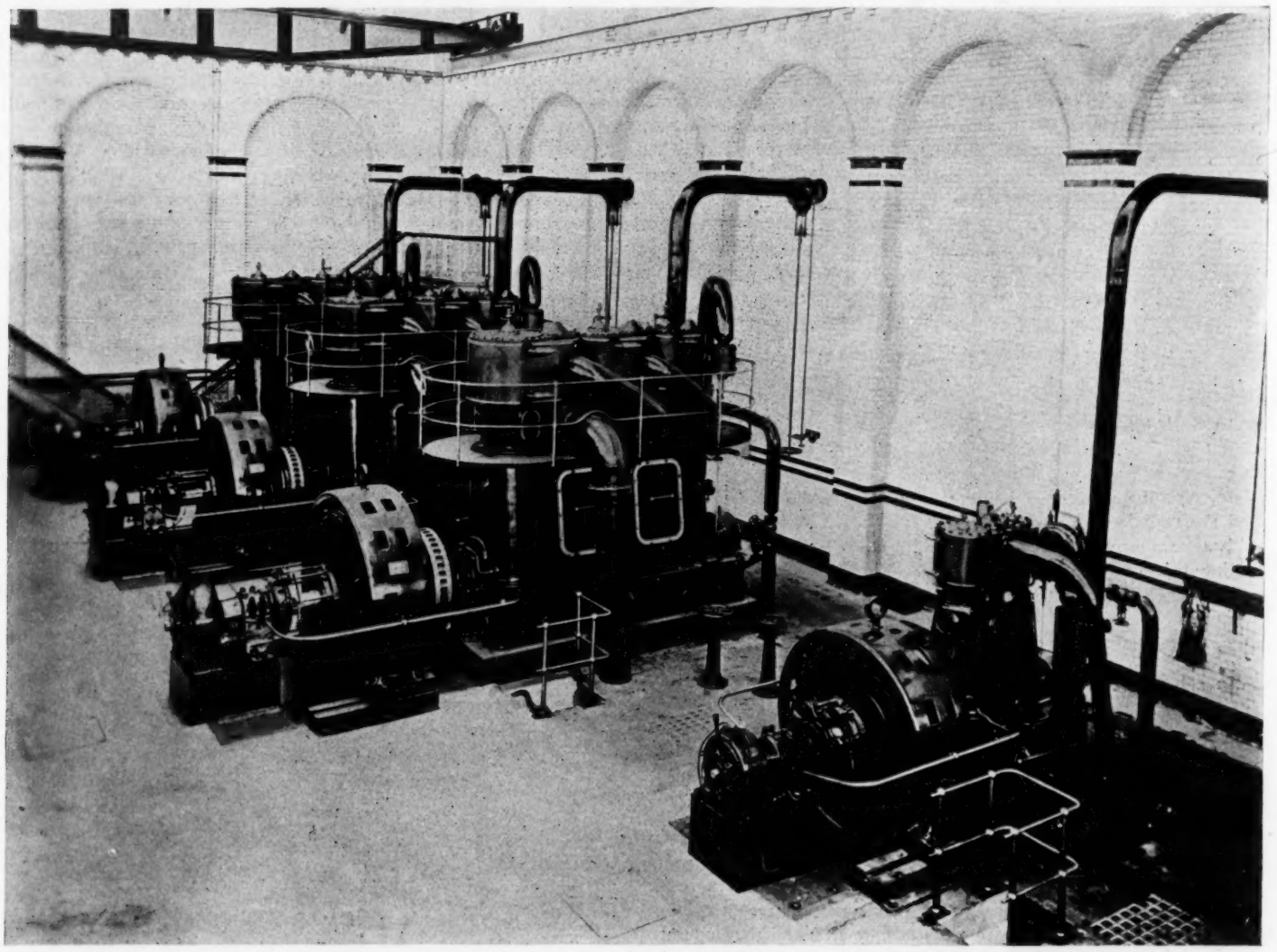


FIG. 1.—ENGINES AND GENERATORS, EXETER CENTRAL STATION.

The new boilers are each capable of evaporating 13,000 pounds of water per hour, and they steam at a pressure of 150 pounds with Welsh coal, hand firing and natural draft. They are, however, as stated above, fitted with chain grate mechanical stokers. After erection the boilers were tested under an hydraulic pressure of 250 lbs. per sq. in.; and the steam and water drums, sections and mud drums under a pressure of 300 lbs. per sq. in. Two of the three feed pumps are steam driven, and one electrically driven. The former are of the Worthington direct-acting type, and are each capable of delivering 2,500 gallons per hour against a boiler pressure of 150 pounds. The electrically-driven pump is of the Worthington three-

throw plunger pattern, and has a capacity of 3,900 gallons per hour; its motor, a two-phase, two-speed Westinghouse induction machine, taking 60-cycle current at either 220 or 400 volts. The two Green economizers each consist of 320 tubes, and work at a pressure of 150 pounds per square inch with cold feed water. The scrapers

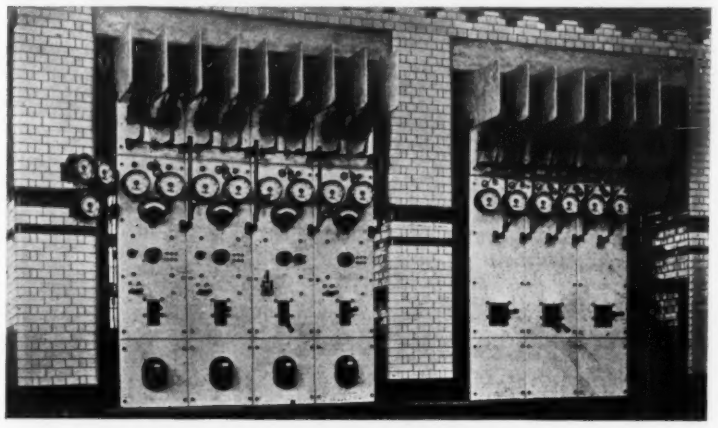


FIG. 2.—FRONT OF SWITCHBOARD.

are of the latest pattern, the driving engine taking steam at 140 pounds pressure.

The engine room plant at present comprises four Westinghouse two-phase generators direct-coupled to Bellis & Morcom engines, three being of 400 kw and one of 100 kw capacity, a total of 1,300 kw. The large sets run at 360 r.p.m. and the small one at 514 r.p.m., the pressure being 2,200 volts and the frequency 60. Steam is supplied at 145 pounds pressure and each engine is connected with a Worthington jet condenser. Each set is capable of dealing with one-hour overloads of 25 per cent., and the engine governors are such as to insure that the variation of steady and momentary speed shall not exceed 5 and 10 per cent., respectively, when full load is thrown

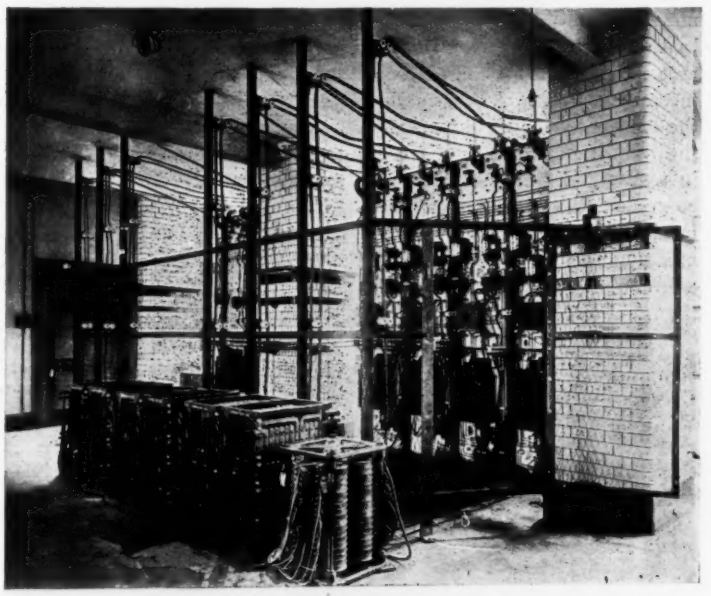


FIG. 3.—BACK OF SWITCHBOARD.

on and off. The exciters are direct-coupled and are of the Westinghouse multipolar type. The engine room is spanned by a 10-ton hand-power traveling crane, the span being 44 ft. and the lift 18 ft.

The controlling arrangements include a combined high and low-tension switchboard for connecting the four generators with the six supply circuits, each generator circuit including an integrating wattmeter. The panels of the high-tension board are of marble and provision is made for the addition of extra ones at any future time. Each alternator and feeder panel is equipped with switches, circuit-breakers, ammeters, etc., of the latest Westinghouse patterns, the alternator panels being also fitted with Westinghouse synchronizing gear. Three station voltmeters with switches and transformers, calibrated up to 2,200 volts, are also fitted. Arrangements are made to enable any desired generator or circuit to be isolated from the main bus-bars and switched on to "hospital bars" for independent working. Figs. 5 and 6 give front and back views of the switchboard and Fig. 7 is a diagram showing the arrangement of the same.

The whole of the work has been carried out on the most modern lines, the layout of the buildings and plant being such as to allow future extensions to be made from time to time. In this connection it may be mentioned that only one-fourth of the available ground area is at present occupied; so that the further increase of the lighting load, the development of the motor load, and the advent of the extensive adoption of electric tramways that is foreshadowed will not be difficult to cope with.

The plans and specifications for the generating station and its equipment were prepared by Mr. H. D. Munro, the city electrical engineer, who had charge of the work from its inception to completion. The British Westinghouse Electric & Manufacturing Company, of Trafford Park, Manchester, obtained the contract for the complete equipment of the new power house, the laying of the new high-pressure mains being entrusted to Messrs. Siemens Bros. & Co. As sub-contractors to the British Westinghouse Company, Messrs. Willey & Co. were responsible for the structural iron work, the coal conveyors (New Conveyor Company's type), coal bunkers, pipe work, etc.; Messrs. Bellis & Morcom supplied the engines; Messrs. Babcock & Wilcox the new boilers; the Worthington Pumping Engine Company the condensers; Messrs. E. Green & Son the economizers, and Messrs. Musker & Co. the overhead traveling crane.

Lesson of the Lackawanna & Wyoming Railroad.

In a discussion of the recent successful sale of obligations, the *Wall Street Journal* says: "The proceeds of the $4,000,000 Westinghouse Electric notes will be used on the Lackawanna & Wyoming Valley electric line, which is now operating twenty miles of double-track electric railway between Scranton and Wilkesbarre. An extension from Scranton to Carbondale, a distance of seventeen miles, is now under construction. The most important engineering work on this extension is a tunnel 4,700 ft. long in Scranton. This tunnel will not be completed until next year.

"This electric road has been built by the Westinghouse people as an object lesson in electric traction. Engineers regard it as the finest piece of electric railway construction ever attempted. While this road is competing with the Delaware & Hudson for passenger traffic, the road was not built to build up traffic at the expense of any other company. The Westinghouse people have great faith in the possibilities of electric traction on steam railways and they wish to show on this line what can be done.

"A very large passenger traffic and a very considerable freight traffic has been developed. The road is now carrying from 7,000 to 8,000 passengers a day. On July 4 it carried 31,000, and it could have carried 45,000 if it had had the facilities for handling the traffic. In addition to the electric passenger trains it is operating on the same tracks both electric and steam freight trains. It is handling about 25 cars of freight a day. Its electric freight cars have double the capacity of the ordinary freight car. Its very elaborate terminals, which are the most extensive ever provided for an electric line, give it adequate facilities for handling freight.

"The day passenger service is operated on a twenty-minute headway and the morning and evening service on a ten-minute headway. Extra cars on a five-minute headway are put on when necessary. Tickets at a rate of 1½ cents per mile are used as much as possible, the cash fare being slightly higher. A telephone system is installed for communicating along the road and is used for dispatching trains and operating them in transit. One lesson that is being taught by this road is that in territory where heavy freight traffic is so profitable that passenger traffic is made a secondary consideration, an electric road can develop a very profitable business."

This admirable system, which has been illustrated and described in our pages from a technical standpoint, has naturally attracted attention in railroad and financial circles, as indicated above, and is evidently now destined to have many successors. As will have been noted from recent items and articles in these pages, some of the trunk line railroads have already become interested in the trolley systems near or paralleling them, while they and other roads have also taken steps to engage in third-rail work along their own rights-of-way. At the present moment it cannot be discerned closely how the movement will work out: but one thing is sure, viz.: that it will go on.

An Expression for the Torque of a Polyphase Wattmeter.

BY F. R. STOWE.

IN an article appearing in the issue of ELECTRICAL WORLD AND ENGINEER for May 28 the writer developed the following equation for the torque in a three-phase wattmeter:

$$T = C\,A\,M_{I_1}\,M_{E_{21}}\,cos\,(30+\phi) + C'\,A'\,M_{I_3}\,M_{E_{23}}\,cos\,(30-\phi).$$

This does not, however, take into consideration the effect of magnetic leakage and the rotation of the disc.

As is well known, in an induction motor the effect of magnetic leakage is the same as that which would be produced by inserting inductances in the stator and rotor circuits, i. e., it will cause a lag of the rotor current.

So our vector diagram for the currents in one set of coils of our induction meter becomes as shown in Fig. 1 (compare with Fig. 3

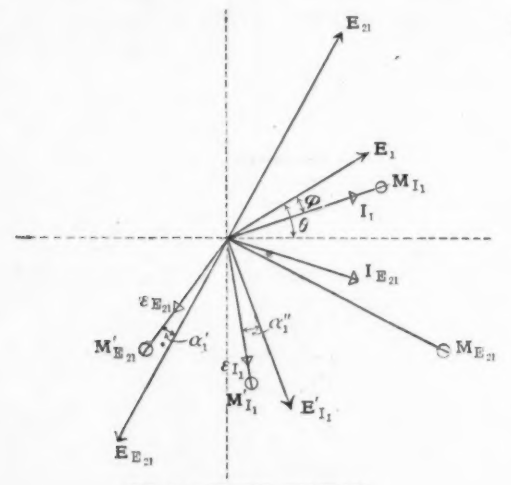


FIG. 1.—VECTOR DIAGRAM.

in previous article), the eddy currents, $E_{E_{21}}$ and E_{I_1}, lagging behind the induced e.m.f's by angles α_1' and α_1''.

The equation for T_1, then, is

$$T_1 = \tfrac{1}{2}\,C\,A\,M_{I_1}\,M_{E_{21}}\{\,cos\,(30+\phi-\alpha_1') + cos\,(30+\phi+\alpha_1'')\,\}$$

Similarly,

$$T_3 = \tfrac{1}{2}\,C\,A\,M_{I_3}\,M_{E_{23}}\{\,cos\,(30-\phi-\alpha_3') + cos\,(30-\phi+\alpha_3'')\,\}$$

Although α_1', α_1'', α_3', α_3'' may be quite large, the differences, $\alpha_1' - \alpha_1''$ and $\alpha_3' - \alpha_3''$, are very small as compared with $30+\phi$ and $30-\phi$, so we may put in place of α_1' and α_1'', $\alpha_1 = \dfrac{\alpha_1'+\alpha_1''}{2}$, and in place of α_3' and α_3'', $\alpha_3 = \dfrac{\alpha_3'+\alpha_3''}{2}$. Then we have

$$T_1 = \tfrac{1}{2}\,C\,A\,M_{I_1}\,M_{E_{21}}\{\,cos\,(30+\phi-\alpha_1) + cos\,(30+\phi+\alpha_1)\,\}$$
$$= C\,A\,M_{I_1}\,M_{E_2}\,cos\,(30+\phi)\,\cos\,\alpha_1.$$

Also $\quad T_3 = C'A'M_{I_3}\,M_{E_{23}}\,cos\,(30-\phi)\,cos\,\alpha_3$,

and the total torque is then

$$T = C\,A\,M_{I_1}\,M_{E_{21}}\,cos(30+\phi)cos\,\alpha_1 + C'A'M_{I_3}\,M_{E_{23}}\,cos(30-\phi)cos\,\alpha_3.$$

Owing to the fact that the eddy currents are not confined to pre-

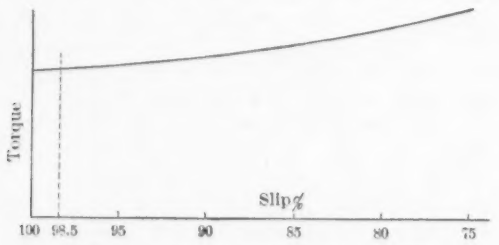


FIG. 2.—PART OF TORQUE-SLIP CURVE.

determined paths, an analytical treatment more exact than this is practically impossible.

The effect of the rotation of the disc can, therefore, be better shown by comparison with data from experiments made on induction motors. An induction meter is a motor with low armature resistance, large air-gap and operating at a slip close to 100 per cent.

The synchronous speed of the meter which has been discussed is about 600 r.p.m., the full-load speed is 9.2 r.p.m., a slip of about 98.5 per cent.

Fig. 6 is a portion of the torque-slip curve of such an induction motor. Referring to this curve, it is seen that the difference in torque between standstill and 98.5 per cent. slip is exceedingly small. As mentioned in the preceding article, this difference in the case of one meter tested was about 2 per cent. At lighter loads it will, of course, be much smaller.

Method for Measuring the Output of Induction Motors.

BY E. ALEXANDERSON.

WHEN induction motors are tested on a commercial basis, an accurate measurement of efficiency and power factor would involve too much complication. In a commercial test as it is usually carried out, no direct measurements of the power are taken, the only instruments used being a voltmeter and an ammeter. The essential parts of the test are as follows: Heat run with resistance measurements: slip readings; run without load; impedance test.

For load is used a direct-current machine, the output of which is measured. In special cases, when an exact measurement of the output is necessary, the direct-current machine is submitted to a separate test in order to determine its efficiency under the running conditions when it was used in connection with the induction motor. In a rough test, however, when this would be too complicated, the output is simply estimated by assuming a certain apparent efficiency of the motor. In the case of a standard type of motor, the apparent efficiency is known with sufficient accuracy; but when one deals with motors of special design, the value of the test is diminished when dependance is placed upon mere assumption. In some cases, when the motor is designed for high overload capacity, it may have an exciting current—70 per cent. of full-load current, and in that case knowledge of the apparent efficiency would be of little use, because the intersections in the power triangle would be too inaccurate to measure the output.

In order to overcome these difficulties without complicating the measurements, I have developed a method which is now being used by the General Electric Company in the commercial test of induction motors. By this method it is possible in every standard test to measure the output at any time while the machine is running. In the same way it would be possible, as will be explained later, to test the output of the motor, while in practical operation, for instance in a shop, without using any instrument or introducing any other complication. The method is based upon the very accurate way of measuring the slip which is offered by a well-known stroboscopic arrangement. A tin disc painted in black and white sectors is screwed to the end of the shaft. The number of sectors is equal to the number of poles of the motor. If an arc lamp fed from the same source as the motor is held near the disc while the motor is running, the sectors will apparently revolve with the speed of the slip. This speed ranges between 60 r.p.m. for small and 10 r.p.m. for large motors, and can be easily counted during one minute. Keeping in mind that 45° = ⅛ of a revolution, it will be readily understood that the slip can be observed even to 1/16 of a revolution at lower speeds.

From time to time there are being proposed methods for measuring the slip of the induction motors. This is specially true in regard to the foreign technical literature. Some of the investigators observe the swinging of a needle or the sound in a telephone. Another has recently described a device consisting of several collector rings, a clock mechanism and a relay*. A common feature in all these methods is that only full, or perhaps half revolutions, can be measured, while the stroboscopic method allows a reading as close as the angular motion of a vector can be observed.

Within the limit of full load the slip is almost exactly proportional to the torque delivered by the squirrel cage or armature winding of the motor. When the motor is loaded by a direct-current machine its output is partially consumed by the output of the generator, which output is measured by direct-current instruments, and partially by the losses in the generator with belt.

The output of the motor armature is, therefore, divided up as follows:

(1) Bearing loss of motor.
(2) Belt loss.

*See Elekt. Zeit. Dec. 24th, 1903, digested in *Electrical World*, Jan. 16th, 1904.

(3) Bearing loss of generator.
(4) Core loss of generator.
(5) I^2R loss of generator.
(6) Output of generator.

If the load of the generator is thrown off, but the excitation (which is taken from another source) is kept constant, the motor will carry the following load:

(1) Bearing loss of motor.
(2) Belt loss.
(3) Bearing loss of generator.
(4) Core loss of generator.

The torques corresponding to the losses 1, 2, 3 and 4 are the same in both cases, although the losses themselves vary slightly when the motor changes speed. If one slip reading is taken in the first and one in the second case, these readings will be proportional to the torques, and the difference between the slip readings proportional to the difference between the torques.

The quantities may be denoted as follows:

	Full load.	D.C. load off.
Slip	S	S_1
Total torque of armature	T	T_1
Total output of armature	P	P_1
Voltampere of generator	VA	

From the above proportion we get:

$$\frac{T}{T-T_1} = \frac{S}{S-S_1}.$$

But the torques are proportional to the outputs at full-load speed.

Hence:
$$\frac{P}{P-P_1} = \frac{T}{T-T_1} = \frac{S}{S-S_1}.$$

The power, $P - P_1$, is known from the direct-current readings:

$$P - P = VA + I^2R,$$

$$P = \frac{S}{S-S_1}(VA + I^2R).$$

This power is the output of the motor armature and includes the losses by bearing friction and windage, P. The counter-torque of these losses correspond to the slip at light run, So.

As above, we find:

$$\frac{Po}{P-P_1} = \frac{To}{T-T_1} = \frac{So}{S-S_1}.$$

$$Po = \frac{So}{S-S_1}(P - P_1) = \frac{So}{S-S_1}(VA + I^2R).$$

The useful output of the motor:

$$P - Po = \frac{S-So}{S-S_1}(VA + I^2R).$$

The constant losses of the generator with belt:

$$P_1 - Po = \frac{S_1-So}{S-S_1}(VA + I^2R).$$

The quantity I^2R is so small that it can be either entirely neglected or estimated from the rated size of the direct-current machine.

When the constant losses of generator with belt have once been ascertained, the output of the motor at any load can be determined by adding these losses to the direct-current output.

In the revolving field had the shape of a perfect sine wave with uniform rotation, the slip at light run, So, would correspond to the bearing friction and windage only. In every motor the field is, however, distorted more or less by higher harmonics, which induce a current in the armature independent of the load. The energy consumed that way in the armature is also taken care of by the slip. The energy loss being proportional to the square of the current, this loss must be extremely small in a good motor, and the slip at light run for practical purposes can be considered as proportional to the bearing friction and windage. This test, therefore, offers means to measure those losses by a direct reading, which is otherwise a rather complicated undertaking.

A number of experiments have been made in order to test the reliability of the new method to measure the output and it appears that the results agree very closely with those obtained by the method which involves a separate test of the efficiency of the generator with belt. The table which is given below shows what can be expected of the method. These readings were taken during a time of about two months upon every motor of a certain type and they can be considered as an average of a purely commercial test:

OUTPUT OF MOTOR.

By separate test of D.C. machine.	By slip.
14.5	14.05
21	21.3
5.1	5.3
10.7	10.45
10.9	10.35
99.3	99
10.9	10.3
99.2	97.5
49.4	46
150	144.5
40.3	40.5
14.1	13.75
10.15	10.4
10.6	10.6
150	144.5
40.3	40.5
14.1	13.75
10.15	10.5
10.6	10.6
9.82	10.4
10.3	10.1
26.1	26.6

Practical instances:

Full-load slip $S = 52\frac{1}{2}$.

Volt-ampere of generator $VA = 128 \times 22.6 = 2{,}890$ watts.

Direct-current load off: Slip $S_1 = 11\frac{7}{8}$.

Running light: Slip $So = 2\frac{1}{8}$.

The machine used for load being a 15-hp, 125-volt machine, its armature resistance can be estimated = .03 ohm, and the I^2R loss $= .03 \times 22.6^2 = 15$ watts. A mistake in this estimate would evidently be of no importance when the I^2R loss (15 watts) is added to the output, 2,890 watts.

Full-load output of the motor:

$$P - Po = \frac{S-So}{S-S_1}(VA + I^2R)$$

$$= \frac{52\frac{1}{2} - 2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}} \times (2{,}890 + 15)$$

$$= \frac{50\frac{3}{8}}{40\frac{5}{8}} \times 2{,}905 = 3{,}605 \text{ watts}$$

$$= 4.84 \text{ hp.}$$

Constant losses of generator with belt:

$$P_1 - Po = \frac{S_1-So}{S-S_1}(VA + I^2R)$$

$$= \frac{11\frac{7}{8} - 2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}} \times 2{,}905$$

$$= 700 \text{ watts.}$$

Bearing friction and windage of motor:

$$Po = \frac{So}{S-S_1}(VA + I^2R)$$

$$= \frac{2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}} \times 2{,}905$$

$$= 15 \text{ watts.}$$

When the output per revolution of the slip has once been ascertained, it is possible at any time when the motor is in practical operation to measure the output by means of a slip reading. All that is needed is to draw on the shaft end with a piece of chalk as many sectors as the motor has poles. If the light of an arc lamp fed from the same source as the motor is thrown on the shaft end, the sectors will appear to revolve with the speed of the slip as stated above. If the motor is installed in a shop, it is very likely that the lamps used for lighting purposes are fed with alternating current from the same power system as the motor, and then no other arrangements need be made. It would therefore be advisable to have the exact speed corresponding to the rated output of the motor stamped on the name plate. To test the output one would only have to subtract the rated speed from the synchronous speed in order to obtain the rated slip. The actual output would then be:

$$= \frac{\textit{measured slip}}{\textit{rated slip}} \times \textit{rated output}.$$

Practical tests of this kind might be valuable in many cases for finding out the power actually required for a certain class of work and whether or not the motors installed are of the proper size.

General Electric Wireless Telegraphy.

It is reported that the General Electric Company has decided to install a wireless telegraph system between its works at Schenectady and Lynn. No details are given.

Local Authorities and Electrical Development in England.

BY W. VALENTINE BALL, M.A. (Cantab).

THE astonishing development of electrical enterprise in the United States appears frequently to have turned the attention of American electrical engineers to England as a field for their labors. England, although she has been waking up during the past few years to the value of electricity as a means of distributing light and power, still holds within her boundaries many important districts which afford scope for electrical development—for development which American engineers are well qualified to direct and control.

Yet it must not be supposed that a certain hesitancy to adopt newfangled ideas is the only cause which has operated to keep the British Islands back in the race for the use of electricity for lighting and tramway purposes. A glance at the statutes which have been passed in connection with electric lighting and the substitution of electricity for horse traction on tramways, will suffice to show that the weapons of obstruction which the Imperial Parliament has put in the hands of local authorities are sufficient to account for much of their lack of development. Further, the cases which have been decided under the various statutes go to show that local authorities have not been slow to make use of the powers thus vested in them.

We have said that a glance at the English statutes will suffice to show that local authorities have the above powers. But, alas! the meaning of English Acts of Parliament is not always clear. In this they are possibly no better than the countless acts in force in the various States of the Union. Further, by an extraordinary system of what is called "legislation by reference," much of the law affecting electric tramways and electric lighting undertakings is to be found in measures which were primarily intended for horse tramways and gas works. Much of this legislation is, of course, excellent; but the legislative method does not tend to simplify research, or to diminish the difficulty of the layman—and especially of the foreign layman—when he seeks to ascertain the canons of English law relating to electric tramways and lighting.

In these circumstances a short essay showing some of the difficulties which may have to be surmounted by the promoters of an electric tramway or lighting undertaking in England may be found useful. To use an American expression, it will be my object to show how far a municipality can object to the grant of a franchise to a private company. It should be remarked at the outset that the author does not purport "to hold a brief" either for or against municipal trading. Much useful work has been done, and is now being done, by municipalities. The object of this article is to show how these bodies are enabled to prevent private companies from entering the field in competition with them.

Dealing first with the question of tramways, it is a remarkable fact that the law which regulates the electric tramways of the present day is founded upon an act passed in 1870, long before electricity was introduced as a motive power.

A tramway properly so-called is inaugurated in England either by a Provisional Order, made by a government department, namely, the Board of Trade, and subsequently confirmed by Act of Parliament, or by a special Act of Parliament. For the present purpose, it is not necessary to go at any length into the two kinds of procedure.

It is provided by Section 4 of the Tramways Act, 1870, that a Provisional Order authorizing the construction of tramways in any district may be obtained by (*inter alios*) "any person, persons, corporation or company *with the consent of the local authority* of such district, or of the road authority of such district where such district is or forms part of a highway district formed under the provisions of 'the Highway Acts.'" A power to veto is thus given both to the local authority and the road authority. These two bodies are usually the same; but the fact that the local authority is also the road authority, as we shall see hereafter, puts a powerful weapon in their hands.

The consent of the local authority is, therefore, a condition precedent to the grant of power to work a tramway. There is only one case in which the consent may be dispensed with. Thus if it is proposed to lay down a continuous line of tramway in two or more districts, and any local or road authority having jurisdiction in any such districts does not consent thereto, the consents of the local and road authorities having jurisdiction over two-thirds in length of the streets and roads along which such line of tramway is proposed to be laid shall be deemed to be sufficient.

The power to withhold consent is firmly vested in the local authority, wholly irrespective of the motive which may lead them to adopt this course. They may even make agreements as to the withholding or grant of leave. In a case decided in 1902 a local authority made an agreement with an individual that they should call on him to apply for powers to make a certain tramway, when they deemed such tramway necessary, and that he, if he obtained such powers, should pay them certain way leaves for the use of the tramway. They also agreed that they would not consent to the application by any one else for such powers without first calling upon the other party to the agreement to apply for the powers. This agreement was held to be within the power of the local authority (A. G. v. Hastings Corporation, 19 T. L. R., 9).

In addition to being able to withhold consent, the local authority also has a right to appear in opposition to a tramway bill which is under discussion before a Parliamentary committee. They may also appear to oppose a bill having for its object the adoption of electrical traction on the tramway. This right to appear in opposition to a scheme is conferred by Standing Order 134 (i. e., one of the rules of Parliament relating to the discussion of private bills before select committees). The rule provides that: "It shall be competent to the referees on private bills to admit the petitioners, being the municipal or other authority having the local management of the metropolis or of any town, or the inhabitants of any town or district alleged to be injuriously affected by a bill, to be heard against such bill, if they shall think fit."

So much for the power of the local authority to refuse consent and otherwise check the development of a tramway in its initial stages. We now pass on to consider the power of compulsory purchase, which is conferred upon the local authority by Section 43 of the Tramways Act, 1870.

It is there provided (in effect) that the local authority may, within six months after the expiration of a period of twenty-one years from the time when promoters are authorized to construct a tramway, and within six months after every subsequent period of seven years, with the approval of the Board of Trade, require the company to sell to them so much of their undertaking as may be within the district of the local authority.

The price is estimated upon "the then value (exclusive of any allowance for past or future profits of the undertaking, or any compensation for compulsory sale, or other consideration whatsoever) of the tramway, and all lands, buildings, works, materials and plant of the promoters suitable to any used by them for the purposes of their undertaking within such district."

In order to avail themselves of this right of purchase, the local authority must (according to the case of Attorney-General v. Bournemouth Corporation (1902) 2 Ch., 714) obtain the consent of the Board of Trade. The following is the general effect of the decisions upon this section:

(I) On a sale to a local authority, the local authority becomes entitled to the exclusive use of the tramway, not by transference from the promoters, but by virtue of the statute alone, and the statute converts what was a terminable right in the promoters into a permanent right in the local authority;

(II) The word "tramway" is not synonymous with "undertaking," but means in this section, as in other parts of the act, the structure laid down on the highway plus the proprietary rights attached to it, but nothing more; hence, its collocation with lands, buildings, works, materials and plant;

(III) "Exclusive of any allowance for past or future profits" means (although present profits are not mentioned) the same as "exclusive of any profits, past, present or future," because there is nothing tangible which can be called "present profits." The principle might have been more simply expressed by saying that there is no allowance on account of good will;

(VI) The result of all the cases is that the amount to be paid in compensation is to be measured by what it would cost, at the date of the sale, to construct the tramway lines, subject to a proper reduction in respect of depreciation, but with no allowance for the rights, powers and privileges of the promoters.

Those qualified to judge have stated that this power of compulsory purchase has done much to injure the development of tramways in the British Islands. It is obvious that with the prospect of being bought up compulsorily hanging over it, no company will

embark upon the purchase of an expensive plant which may fetch old iron prices in the course of a few years.

There are certain other methods by which a local authority may interfere with tramway enterprise. Space, however, does not permit me to enlarge upon these.

The Electric Lighting Acts contain provisions which are an exact parallel of those which we have just considered, subject to certain qualifications. Every application for a provisional order or special act for the supply of electricity for lighting requires the consent of the local authority, while the Electric Lighting Acts, the provisions of which are always incorporated, provide for the compulsory purchase of every undertaking at some future time.

The general effect of the Electric Lighting Acts, 1882 and 1888, with regard to consent is as follows: The consent of every local authority having jurisdiction within the area or any part of the area within which a supply is to be furnished must be obtained by the company. Consent may be given upon terms, and not infrequently it happens that a local authority insists upon the company supplying energy at special rates to public lamps.

Unlike the Tramway Acts, the Electric Lighting Acts confer upon the Board of Trade power to dispense with the necessity of obtaining the consent of the local authority. This power may be exercised in any case in which the consent of such local authority is refused, and the Board of Trade is of opinion that, having regard to all the circumstances, such consent ought to be dispensed with.

Consent has been dispensed with in several cases, and a movement is now on foot to introduce an Act of Parliament which is to take away what really amounts to an absolute right of veto from local authorities. It might be observed that the movement to dispense with the necessity of obtaining the consent of the local authority is founded upon the report of a committee in 1898. It was stated in that report that "The committee considers that the provisions of the Electric Lighting Act, 1888, which requires the consent of the local authority as a condition precedent to the granting of a provisional order, should be amended. In their opinion, the local authority should be entitled to be heard before the Board of Trade, but should not have, so to speak, a provisional veto, only to be dispensed with in special cases by the Board of Trade."

We have seen that tramway companies have the prospect of compulsory purchase continually hanging over them. Electric lighting companies are subject to a similar disability. It is worthy of remark, however, that whereas by an electric lighting act passed in 1882 the power to purchase compulsorily was to have been capable of exercise within twenty-one years from the commencement of the act, this period was extended to forty-two years by the Electric Lighting Act of 1888. The admitted reason for this change was that the prospect of being bought up at old iron prices proved fatal to the prospects of the electric lighting industry.

The working of the compulsory purchase clause (Section 2 of Act of 1888) merits careful attention. It provides that the local authority may, within six months after the expiration of forty-two years from the passing of the act confirming the provisional order, give notice to the undertakers to sell the undertaking. Thereupon the undertakers are to sell and the local authority must purchase "upon terms of paying the then value of all lands, buildings, works, materials and plant of such undertakers suitable to and used by them for the purpose of their undertaking within such jurisdiction." The value of the lands, etc., is to be deemed "their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials and plant; and to the state of repair thereof, and to the circumstance that they are in such a position as to be ready for immediate working, and to the suitability of the same to the purposes of the undertaking, and, where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase or of good will, or of any profits which may or might have been or be made from the undertaking, or of any similar considerations."

It is clear that a power of compulsory purchase which may practically involve the company in the loss of its good will is not likely to prove beneficial or encouraging. The time, however, is not yet ripe for compulsory purchase of electric lighting undertakings, and it is impossible to predict how far the local authorities will avail themselves of the privilege. Enough has been said to show that existing legislation gives them a deterring power.

One aspect of the question under review remains to be considered. Under the law of England, it is competent for any person to generate electricity and supply it to his neighbors upon terms which may be mutually arranged. This privilege can be exercised without the leave or license of Parliament and without the assent and in spite of the dissent of any local authority. So long as the supply is given without nuisance to neighbors, the person or company giving the supply may do so without any interference.

Although a local authority has no direct statutory power to interfere with the private supply of electricity, yet there are ways in which obstacles may be thrown in the path of those who undertake to give a supply otherwise than in accordance with the terms of a provisional order. Thus it is obvious that no scheme of any magnitude can be inaugurated without it becoming necessary for cables to be laid under or over streets or highways. If the cable is laid under a highway the highway authority (i. e., the local authority) may object to the surface of the road being disturbed; if a cable is suspended over the highway, objection may be raised on the ground that it is likely to interfere with traffic. Where, however, it is suspended at such a height as to be far above the reach of the traffic its erection may still be objected to on the ground that it constitutes a trespass. Hence, if the fee simple of the road is vested in the local authority—or, to use a term better known to American lawyers, if the local authority has eminent domain in the soil of the road—they can proceed to the court and demand the removal of any cable which passes under or over the road which is under their care. But it is essential for them to show that their title is one of eminent domain. In a case which excited considerable interest in England some years ago, a private company had commenced to supply electricity in one of the metropolitan districts. By arrangement with persons whose premises abutted on the highway, they placed posts in suitable position and suspended cables over the streets at a sufficient height to be out of the way of the traffic. The local authority, who had themselves obtained a provisional order for the supply of electricity in the district but had not put it into force, feared the presence of what might prove to be a formidable rival. They accordingly instructed their engineer to cut down the cables which were suspended over the highway. Upon his proceeding to carry out his order the company applied to the court for an injunction to restrain interference with its property. When the case came on the local authority sought to show that their title to the highway was in fee simple or eminent domain. In the event, however, they failed to make out this title, and their interest as highway authority was held not to be sufficient to give them the right to ask for the removal of the cables.

New Telephone Patents.

TELL-TALE SIGNAL FOR USE WITH COIN COLLECTOR.

That the later type of coin collector for pay stations, that in which the depositing of a coin is within the control of the operator at central, at times fails, due to neglect of the operator to perform her duties properly, is evidenced by the issuance of a patent covering a tell-tale signal for use in connection with such pay stations. It may be readily understood that, if the operator fails to deposit the pay station coin upon the successful completion of a connection, the coin chute soon becomes choked, defeating one or more of the functions of the apparatus.

Usually the control of the pay station lies in one or more keys associated with the operator's cord circuit, these making such abnormal circuit arrangements as to cause coins to be deposited or returned. The tell-tale signal may, therefore, indicate merely the failure to operate the controlling keys. The inventor, Mr. F. R. McBerty, of Evanston, Ill., has arranged extra relays in the cord circuit, the operation of which are such that a lamp or other signal is displayed each time a pair of connecting cords at any operator's position is disconnected from the spring jacks of any two lines before the coin for which the connection was made is disposed of. Mr. McBerty has assigned his patent to the Western Electric Company, of Chicago.

TOLL REGISTER.

Another patent describes a toll register to be placed at the subscriber's premises and operated by him by means of a plunger. The organization of the system requires that the plunger shall be depressed to count one immediately upon the response of the oper-

ator. Now, however, if the connection fail for any reason then will the operator, through the agency of an electromagnet, subtract the count just added from the register. Hitherto a fear of such type of counter has been felt, because of the ability of any operator to step off all the calls at her convenience. The danger from this is largely done away with in the present device, for as soon as one count has been subtracted it is made impossible to subtract a second one until the deducting apparatus has been reset by the adding of a count. H. D. Stroud, of Chicago, is the inventor of this register, he having assigned his patent to the National Measured Service Co.

DESK STAND SET.

Mr. P. C. Burns, of Chicago, has obtained a patent for improvements in the "knock-down" type of desk stand set, such as that manufactured by the American Electric Telephone Company, to which company he has assigned his patent. In the improved set the base is made as a hollow box, forming a receptacle for the induction coil of the set. This box carries at its middle a hollow stud upon the end of which the base plate screws so as to be held in position independently of the main assembling screw. This latter is reached through the hollow stud, its head bearing against a shoulder within its base. To prevent losing the screw a pin is run through it just above the shoulder, which, therefore, acts as a stop between the screw head on the one side and the pin on the other.

ELECTRIC LIGHT SWITCH FOR BOOTHS.

A semi-automatic switch for controlling an electric light within a telephone booth forms the subject of a patent issued to John L. Bolan, of South Connellsville, Pa. The spring-actuated switch arm is released to light the lamp by the vibration of the bell hammer. After use it must be reset to the "off" position by hand.

CORDLESS SWITCHBOARD.

Some months since there was noted in this column a type of cordless switchboard invented by I. Kitsee, of Philadelphia. In this system a plunger, which travels within what corresponds to the jacks of the switchboard, automatically selects one of a series of conductors, which serve as connecting circuits. Then, automatically, the plunger of the desired line will select the same connecting circuit, if it be the next one to be depressed. The present patent is based upon a division of the application of the former patent.

Models at St. Louis of Pennsylvania-Hudson River Tunnel and Terminal.

Among the extensive exhibits of the Pennsylvania Railroad Company in the Transportation Building at St. Louis the ones of most interest to electrical engineers are the models showing the work in connection with the New York terminal now under construction for that company. A full-sized section of one of the two single-track tunnels under the Hudson River is exhibited, as shown in Fig. 1. It consists of a cast-iron shell lined with concrete. On each side of the track are terra cotta ducts for electric wires. In the limited space available above the top of the car is placed an overhead conductor, which, on the model, is a wide strip of steel supported by porcelain insulators from the concrete roof. The third rail has its center 26½ in. outside the gauge line of the track and its top 2¾ in. above the track. It is protected by two planks, a 9-in. plank on top and a 6-in. plank at the side, and is supported on vitrified clay insulators. The track in the section illustrated, which is to be used in passing through the silt in the bottom of the river, is supported on steel screw piles, which extend below the tunnel of solid rock. The top of one of these steel screw piles, under the middle of the track, can be seen in Fig. 1. An I-beam parallel with the ties rests on the screw pile, and this in turn supports longitudinal girders, upon which the ties rest. In Fig. 2 are shown models of sections of the tunnel. That at the right is a three-track tunnel, as constructed under the streets of New York City. In the middle are two single-track tunnels side by side, as constructed in solid rock, and at the left is a single-track tunnel as constructed through solid rock.

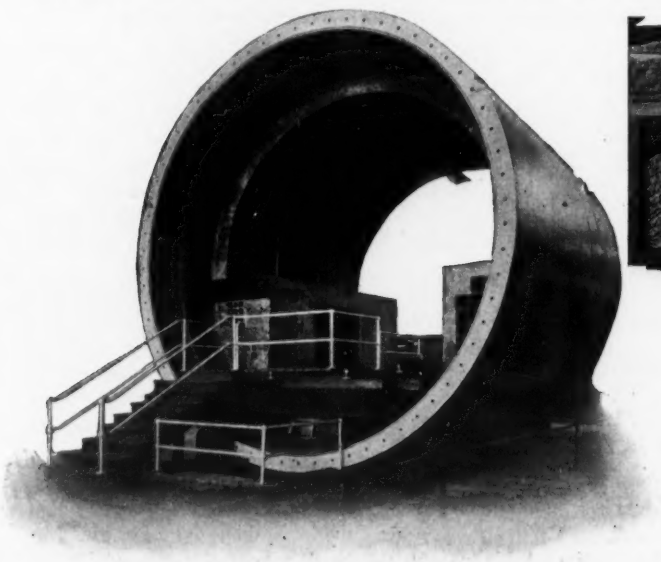


FIG. 1.—FULL-SIZED SECTION OF TRACK.

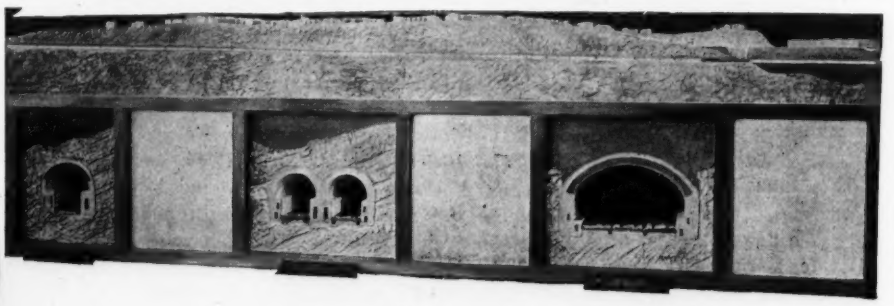


FIG. 2.—CROSS-SECTION OF THE TUNNELS.

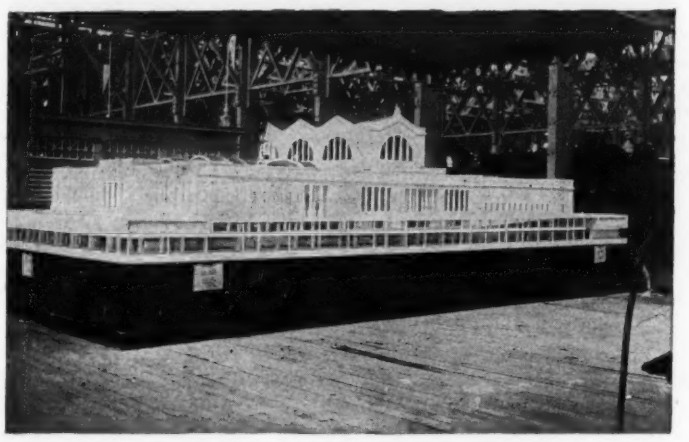


FIG. 3.—MODEL OF THE MANHATTAN TERMINAL, PENNSYLVANIA RAILROAD.

Fig. 3 shows the model of the great Manhattan terminal which this company is to build between Seventh and Eighth Avenues, Thirty-third and Thirty-first Streets. This model shows the train shed for depot purposes. On this model trains are shown as being coupled to one or two eight-wheeled electric locomotives, from which the natural inference is drawn that electrical locomotives connected together by the multiple-unit system will be employed, with as many locomotives per train as may be necessary.

Motors for Machine Tools.

In order that motors may produce the slow forward working stroke and the rapid return idle stroke in machine tools, R. H. Stevens and S. S. Wales, according to a patent issued July 26, 1904, propose to connect two direct-current motors in series on the forward stroke and in parallel on the return, thus doing electrically what is usually accomplished mechanically by means of crossed belts, idle pulleys and shifting devices. The very favorable economy obtained by the installation of electric drive may render such schemes of use in some cases, but the necessity for two motors for each tool operated, which motors are worked to best advantage only on the idle stroke, would seem to be somewhat objectionable.

CURRENT NEWS AND NOTES.

WORLD'S FAIR TROLLEY TRAFFIC.—Nearly 15,000,000 more passengers were carried by the St. Louis Transit Company during the three months which ended June 30, 1904, than during the first quarter of the year. The figures also exceed by 12,000,000 the second quarter of 1903. The quarterly report of the company, filed a few days ago, shows that during the months of April, May and June there were made 1,551,168 trips, upon which were carried 50,027,717 passengers. During the same period of 1903 there were 1,367,454 trips made and 38,421,172 passengers carried.

POWER FOR LYONS FROM ALPS.—Private advices received in New York City from Col. Turrettini, the distinguished hydraulic engineer, of Geneva, Switzerland, state that the Société Franco-Suisse pour L'Industrie Electrique, in which he is interested, has begun construction work on a scheme for the delivery of power in Lyons, the great silk and industrial center of Southern France, from the Alps. The length of transmission will be 200 km.—about 125 miles—and a potential of 36,000 volts will be employed. It is the intention to transmit several thousand horse-power, for which an excellent market exists.

DEPRECIATION OF ELECTRIC APPARATUS.—In a communication made by the Standard Electric Light Company, in view of the proposal for the establishment of a municipal plant at Danville, Pa., is included certain data as to the depreciation of electric plants. It is stated that the Toledo (Ohio) municipal plant, which cost $2,000,000, was advertised for sale after three years' use and the highest bid made was $300,000. Gravesend, L. I., after paying $120,000 for electrical apparatus sold it at the end of three years without any intermediate use for $30,000. At Carbondale, Pa., machinery which had been running on an average of ten years was sold for junk when replaced by machines of larger capacity.

MOTOR-OPERATED FIRE EXTINGUISHER.—An elaborate system for extinguishing fires is disclosed in a patent issued July 26, 1904, to Joseph Butcher. Rather than depend upon automatic sprinklers, which allow water always under pressure in the pipe to flow continuously when a certain fuse is melted by the excessive heat, the inventor installs at each sprinkler a thermostatic device, which, when the temperature exceeds a determined value, opens a valve at the particular sprinkler and also causes an electric motor to operate a valve admitting water to the previously dry pipeline. When the fire is extinguished, all water valves and electrical connections are automatically restored to normal condition, a feature which has, doubtless, been considered of paramount importance.

DANGER SIGNALS FOR RAILWAYS.—To avoid the possibility of collision between trains and to warn the engineer when he approaches an open switch, Joseph H. Harrel, according to a patent issued July 26, 1904, would install a battery and a bell upon each train and arrange a complete metallic circuit along the track (using one rail and an added wire) with contacts suitably disposed along the route and with proper sliding shoes on the train, so that when two trains occupy the same block at the same time the circuit through the two bells and the two batteries will be completed and the engineers will be properly warned. By introducing the rail switch electrically into the metallic circuit an alarm will be sounded by the bell when a switch is opened in a block occupied by the train.

MR. ROCKEFELLER'S LIGHTING PLANT.—Advices from Tarrytown, N. Y., state that after much experimenting John D. Rockefeller has decided that so far as he is concerned the operation of a private electric light plant is a failure. He has signed a contract with the local Westchester company to light his estate of about 5,000 acres at Pocantico Hills. As soon as the new service is begun his private plant, which cost about $10,000, will be for sale at a bargain price. About 800 incandescent lamps are required to light the house, grounds and private park. They will be operated at once. Mr. Rockefeller put in a private lighting plant about a year ago when he thought that his bills were too large. The dynamos were set up in one end of the barn. After operating a short time Mr. Rockefeller discovered that the new system was costing more than the electricity formerly supplied by the lighting company. There was also the constant danger of burning the barns, which cost about $200,000. He continued the service, however, until the year was up and then notified his superintendent to make a change. It is said that the plant cost Mr. Rockefeller not less than $30,000, instead of $10,000, as stated.

CRANE MOTOR CONTROLLER.—The manually operated controllers for adjusting the resistance used with motors for driving cranes, conveying bridges and similar machinery increase in size with increase of power of equipment, so that in many cases the output of the machinery is limited by the physical endurance of the operator in manipulating the controller. In order to eliminate difficulty from this source and to decrease the cost for cables to supply power to moving motors, A. C. Eastwood has devised certain arrangements of electromagnetic relays which form the subject of a patent issued July 26, 1904. The scheme employed, as illustrated in the drawing of the patent, involves the use of thirteen electromagnets, which are operated from a barrel-type controller that may be handled with the same ease as the miniature master controllers employed with multiple-unit systems. The inventor proposes to utilize the generative power of the motor when driven mechanically by the load, dissipating the energy in the starting resistance, thus relieving the gearing mechanism and friction devices of the equipment from the deterioration incident to absorbing the energy liberated when lowering the load or bringing the motor to rest.

THE WIRELESS AT NANTUCKET.—A special dispatch from Nantucket, Mass., of August 1 says: "Since the Government ousted the Marconi wireless telegraph from the Nantucket South Shoals Lightship the company officials have come to the conclusion that they can exchange wireless messages with liners without the aid of the relaying station on the lightship by simply increasing the power of the plant in Siasconset and on board the steamship. Mr. William Bradford, one of Marconi's experts, is now in Siasconset making a series of experiments with a view of ascertaining how much power will be necessary to transmit messages to the steamships, which pass about sixty miles south of this island, and it is believed he has succeeded in sending several messages to vessels within the last few days. Just as soon as the instruments were removed from the lightship it was noticed that receiving instruments in Siasconset were slightly affected at certain times, and sometimes whole words were recorded. At first the operators were somewhat puzzled as to the cause, but on learning that several steamers had endeavored to communicate with the lightship, not knowing that the apparatus had been removed, they quickly concluded that the dots and dashes received at Siasconset were parts of messages sent from the steamers."

CONSTANT-CURRENT REGULATOR.—A patent issued July 26, 1904, to James J. Wood has for its object improvement in regulators for maintaining constant current in alternating circuits. The regulator to which the invention applies is of the well-known variable-inductance type, consisting of a coil and magnetic core, movable with respect to each other, the relative positions of which determine the inductance of the combination. In the ordinary disposition of the coil and core the two are held apart by gravitational forces and are drawn together by the current to be regulated, the value of the current being decreased as the two approach each other, so that by properly designing the suspended parts and the mechanical interconnection between them, practically constant current may be obtained. The present invention relates to certain improvements in the arms which serve to suspend the coil and core, by means of which the current may be maintained absolutely constant throughout the operating range or either increased or decreased with increase of load (external voltage). Certain cam motions have frequently been employed for this purpose, but the inventor prefers to use arms adjustable in relative positions at will by means of a screw and lock nut. In order that the same regulator may be capable of operation at several frequencies and several e.m.f's (range of e.m.f. variation) with change of circuits, the inventor constructs the coil in the form of an auto-transformer with taps independently arranged for various frequencies and other taps arranged for various e.m.f's, so an adjustment for change in frequency in no way affects the voltage range, or the voltage range may be altered without interfering with the frequency adjustment. It is certainly not immediately apparent that an auto-transformer in a series circuit is capable of such entire independence of adjustment.

A SOLUTION OF THE MUNICIPAL OWNERSHIP PROBLEM.—The city of Wausau, Wis., has recently made with the electric company of that place a contract which seems to have given great satisfaction to both parties and to the citizens. The city is to own the distributing system and lamps for street lighting and to purchase current from the electric company. On the basis of a consumption of 3,040 lamp-hours per annum the price per kilowatt-hour is placed at 2.3 cents, or approximately $29.40 per lamp per annum. The lamps are the 420-watt type, taking 6.6 amp. constant alternating current in series circuit. It is estimated that, including installation and maintenance of pole lines and are lamps, the cost to the city will be $45 per lamp per annum. This arrangement was worked out by Mr. Jacob Cloos, consulting engineer of Milwaukee.

A RADIUM CLOCK.—A radium clock, which will keep time indefinitely, has been constructed by Harrison Hartindale, of England. The principle of this apparatus is simplicity itself, the registration of time being made in two-minute beats, while its function is to exhibit the dissipation of negatively charged α and β rays of radium. The clock, according to the *Scientific American,* comprises a small tube, in which is placed a minute quantity of radium supported in an exhausted glass vessel by a quartz rod. To the lower end of this wonderful little tube, which is colored violet by the action of the radium, an electroscope formed of two long leaves or strips of silver is attached. A charge of electricity in which there are no β rays is transmitted through the activity of the radium into the leaves, and the latter thereby expand until they touch the sides of the vessel, connected to earth by wires, which instantly conduct the electric charge, and the leaves fall together. This very simple operation is repeated incessantly every two minutes until the radium is exhausted, which in this instance it is computed will occupy thirty thousand years.

TELEPHONE CLERKS IN GERMANY.—United States Consul Monaghan, of Chemnitz, in his recent communication to the United States Department of Commerce and Labor, reviews briefly the conditions and requirements which are of interest as showing the progress of women in the fatherland. It is not every woman who can obtain a position in the German postal service, so strict are the government regulations respecting age, character, education and health. A government medical examiner pronounces upon the health, which must be perfect; the age must not exceed thirty or be under eighteen, and a good common school education is a primary requisite. Possessing all these qualifications, the woman candidate is eligible only to a position as assistant in the post office, and the highest salary she can hope for is $119 a year. In the telegraph and telephone service, however, all grades of positions are open to women, though the rules of admission are equally strict, and no women with children are employed. Four thousand women are now engaged in the telephone service of the German Empire, it is stated, one thousand of them being in Berlin. The hours are light, ranging from six to eight a day. The highest pay which a woman can draw in German telephone offices is $357, which is said to afford a comfortable living in Germany, but it is a low wage compared to that to be obtained in England, where experienced telephone clerks get $600 and the chief inspectors are paid as high as $2,500. In Germany, however, it must be noted that women, on their withdrawal from active labor after the prescribed number of years of faithful work, are awarded a government pension on the same plane with the men.

MONEY BY CABLE.—Referring to modern methods of making cable transfers of money, the New York *Evening Post* says: "During the rise of nearly 5/8 cent per pound in sterling exchange early this week, all market reports made much of the 'heavy demand for cables.' This meant that London needed some millions of money urgently and needed it at once, and that, for an extra charge of about half a cent per pound, the money was thus remitted. How was it done? A sight draft is one thing; documents and comparisons settle that. But with a cable, how can absolute safety be assured for payment in the millions? Cases frequently arise where signatures are forged and money is obtained on checks or on money orders. But an instance is yet to be reported where funds sent by cable transfer went astray. The precautions taken are simple, but effective. The principal safeguard is a cipher word, by which each firm or individual engaged in the foreign exchange business is designated. This code word is not known outside of a small circle of employees. Furthermore, there is no chance for dishonesty among employees, even if a number of them are acting in collusion. On each side of the water the papers have to pass through half a dozen hands or so before the transaction is properly closed or audited. The buyer of a cable transfer must of necessity have a correspondent on the other side who is well known, or at least who can be identified. No money would be paid to him without identification. If he represents a firm engaged in exchange, or if he is merely operating on his own account, he must give the code word which is designated in the order or draft before he can get the money, and the amount that he wants must correspond with that sold here."

LETTERS TO THE EDITORS.

Single-Phase Energy Meter.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of the 23d inst., under the heading of "Digest of Current Electrical Literature," a motor system is described for "A Single-Phase Energy Meter," this description being abstracted from *L'Industrie Elec.,* June 25.

With reference to this motor system, I merely beg to say that as far as the shunt or potential system is concerned, it embodies the same principles as have been used in induction wattmeters built by the Stanley Instrument Company for a number of years, and covered by United States patent No. 653,815, issued to William Stanley, which describes a means for lagging the current in the potential system to quadrature by means of a shunted magnetic circuit or magnetic bridge, which is shown in Fig. 4 in the article given in your issue of the above date.

GREAT BARRINGTON, MASS. E. W. GOUGH.

Motor Speed Control.

To the Editors of Electrical World and Engineer:

SIRS:—The progress which electricity is making as a motive power for driving machinery indicates a marked appreciation of the capabilities of the electric motor for speed control as compared with the customary intermediary mechanism of counter-shafting, pulleys, gearing, etc., now generally employed with the majority of machines.

Procrastination in respect to more extensive developments in this line is due to the fact that an entirely satisfactory electric system or motor, that can comply with the prevailing extremes of speed requisites, does not exist in tangible form. The indications are that complications cannot be entirely evaded, but simplicity in the equipment for driving machines by electric power seems best obtained by using a combination of machine and motor as a compact unit, incorporating the functions of speed varying wholly within the motor, and adapting it to the single potential systems which are universally standard. The substitution of one motive power for the other could gradually be accomplished without causing the dismantling of machines in use or entailing the expense of installing a special form of generating system.

The simplest and most available method for obtaining speed variation is the one which involves change in field strength, but upon investigation certain limitations are early realized with respect to commutation on account of field distortion due to armature reaction.

Variation of self-induction is due to the fact that the pole tip magnetism is utilized to neutralize self-induction, and such magnetism being a common part of the field is subject to the varying strengths of such field. Under these conditions there is a varying state of commutation unless other factors, which comprise coil reactance, be correspondingly and inversely varied. Reduction of the armature current, and in consequence thereof a decrease of power of the motor, results in a proportionate degree with increase of speed unless special precautions be taken to maintain the commutation limits.

The fact is that reversible constant-speed motors, with brushes fixed equidistant between pole tips, of both the shunt and series types, operate successfully in commercial practice. Speed variation by change of the field strength is more satisfactorily accomplished if

the field be prevented from actively affecting the commutation. Consideration of this fact leads to the conception of employing an auxiliary field, reference to which was made in a former contribution to these columns (October 3, 1903). In this connection it is interesting to note in the Digest of April 9 a reference to the Lanhoffer double-field dynamo as a rotating transformer, booster and variable-voltage dynamo. The voltage-varying characteristics of this form of dynamo correspond to the desired qualities in a speed-varying motor.

The operation under ordinary circumstances is exactly similar in varying the voltage of a dynamo and the speed of a motor through the field as the regulating medium. The normal armature current depending upon the type of machine must be approximately reduced in proportion to the reduction of field. In each case there is required increased weight to insure the desired power at the unfavorable extremes of highest speeds in the motor and the lowest voltages in the dynamo. By constructing a motor in the manner indicated by Lanhoffer there is, of course, involved the additional cost due to employing a double set of field coils, and also that due to a slightly longer armature; but the material and weight irrespective of the speed range, which may be reasonably great, is approximately constant, and is the same as that of a constant-speed motor at the lowest speed. Speed ranges of 5 and 8 to 1 are obtainable at very little extra cost. Ranges above this do not seem to be impossible with the use of a special compound winding on the main commutating field or through the use of other means for subduing the tendency to spark at the commutator.

CHICAGO, ILL. ALBERT F. HEMINGWAY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Giving Constant Voltage at Varying Speed.—LOPPE.—An illustrated description of his system for getting constant voltage from a direct-current dynamo running at any speed beyond a certain limit. For this purpose it is necessary that the exciting current be inversely proportional to the speed of the dynamo, and this requirement is sufficient as long as the dynamo is operated in that part of its characteristic curve in which the magnetic flux is proportional to the exciting current, and as long as armature reaction does not interfere. If the voltage shall be constant for any speed beyond w_1 the exciting current must vary with the speed of the dynamo as indicated by the equilateral hyperbola curve, *C D*, in Fig. 1. This condition may be approximated by exciting the dynamo from a storage battery and inserting in the exciting circuit a small auxiliary dynamo with constant excitation; this auxiliary

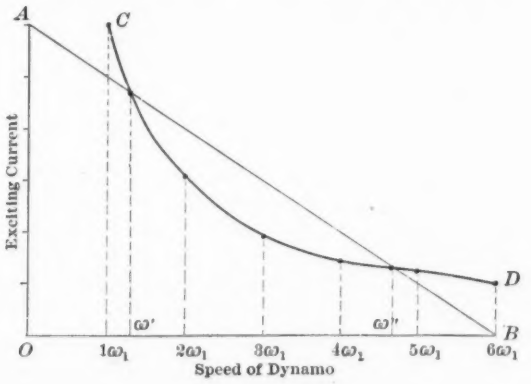


FIG. 1.—CURVE.

dynamo is mounted on the same axle as the main dynamo and the connections are so made that the e.m.f. developed by the auxiliary dynamo counteracts the e.m.f. of the battery. It acts, so to speak, like a negative booster. The higher the speed of the main dynamo, the higher will be the speed and the e.m.f. of the auxiliary dynamo, so that the exciting current of the main dynamo will be the smaller the higher its speed. The way in which the exciting current depends on the speed with this arrangement is indicated in Fig. 1 by the straight line, *A B* (instead of the equilateral hyperbola, *C D*, which corresponds to perfect regulation). Further regulation may be obtained if the excitation of the auxiliary dynamo is not kept constant, but is varied with the e.m.f. of the battery; it is possible to connect the exciting circuit either in shunt with the battery or to insert it in series in the charging circuit of the battery. Of course, it is also possible to combine both methods of regulation. The second method gives an excellent regulation since the intensity of the charging current of a battery varies much more rapidly than the voltage at its terminals; for instance, in practice, if the voltage at the terminals of the battery is raised 10 per cent., the charging current is more than doubled. Fig. 2 gives the arrangement of the system. *A* is the main dynamo, *B* the auxiliary dynamo, *a b* the exciting circuit of the auxiliary dynamo and *m n* the exciting circuit of the main dynamo. The author gives results of a test showing that a dynamo gave practically constant voltage (between 33 and 35) for all speeds between 400 and 2,200 r.p.m. *Rh* is a rheostat, which enables one to vary the charging current for the battery. The method is applicable for electric lighting of railway cars from a dynamo

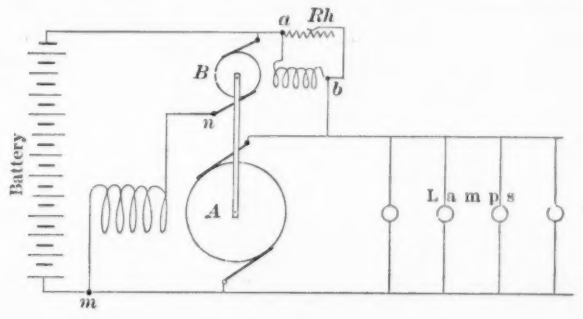


FIG. 2.—DIAGRAM OF ARRANGEMENT.

mounted on an axle for lighting from windmills, etc.—*L'Ind Elec.*, June 25.

Self-Exciting and Compound Alternators.—An article on recent developments of the Heyland method. His method of self-exciting and compounding three-phase alternators of the revolving-field type does not necessitate any alteration to the standard design beyond replacing the exciter by a commutator of special construction (with three sets of brushes) and winding the magnet wheel with a number of interconnected parallel circuits, which are connected up to this commutator instead of to the usual slip rings. If the three sets of brushes are connected to the alternator terminals by means of a small pressure transformer, the machine becomes self-exciting, and if, in addition, they are connected into the armature winding (for instance, at the neutral point) with the help of a

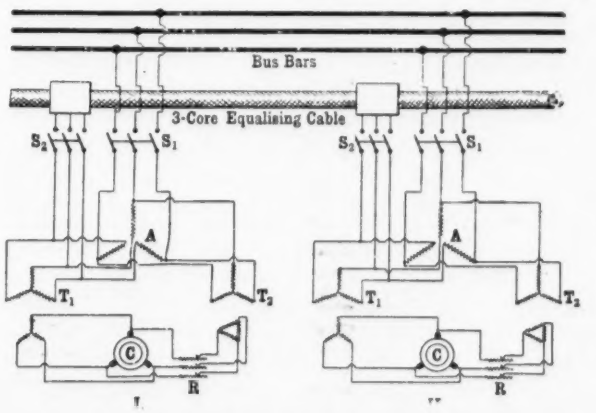


FIG. 3.—CONNECTIONS FOR PARALLEL OPERATION.

current transformer, the machine can be arranged to compound itself for constant terminal pressure at any load and power factor, or to overcompound, if desired. Such machines are synchronous,

and their performance differs in no respect from that of standard alternators, excepting that they have no pressure drop. Their method of operation is also precisely the same, except that no hand regulation of the field circuit is required to keep the pressure constant and that the alternators must be connected by an equalizing conductor when in parallel, just as in the case of compounded continuous-current machines. The connections of two high-pressure, three-phase generators operating in parallel are indicated in Fig. 3, where A represents the armature winding of the generators, C the commutator for the field winding, R the field regulating resistance, S_1 the three-pole main switch, S_2 the three-pole equalizing switch, T_1 the current transformer for compounding and T_2 the pressure transformer for the excitation. The equalizing conductor is a three-core cable. If the neutral points of the generators are earthed, the equalizing switches and cable are but a few volts above earthed potential. Several curves are given representing results of tests of such machines. The only disadvantage that has been met with in these compounded generators is in connection with the low-pressure excitation. Considerations of commutation require that this pressure should not be more than about 30 volts, and this means that the leads between the machines and the regulator on the switchboard become somewhat heavy and expensive, as does also the regulator itself. This does not apply to the compounding circuits, as the series transformer is mounted directly on the generator in the position that would be otherwise taken up by the exciter, and consequently the length of these leads is reduced to a minimum. Heyland now proposes the following modification: Instead of making the generator self-exciting and compounding, he retains the direct-coupled exciter and compounds the latter. The exciter is provided with a supplementary, interconnected, multiple-circuit winding on its field system, in addition to its ordinary shunt winding, the supplementary winding being supplied through a current transformer and commutator. The latter must rotate synchronously, and can be placed either on the shaft of the alternator (or direct-coupled exciter) or it can be independently driven by a small synchronous motor. The commutator is quite small, since it has to carry only the compounding currents which form but a part of the total excitation of the alternator. The exciter with its main (shunt) winding furnishes then the excitation necessary for the alternator at no load. As the load comes on, the field of the exciter is correspondingly increased, owing to the converted current, which is proportional to the load current and circulates in its auxiliary field winding. With this arrangement the commutator and brushes exchange their functions. The brushes are connected to the various circuits of the auxiliary winding on the exciter field magnets, while the compounding currents are led into the commutator with the

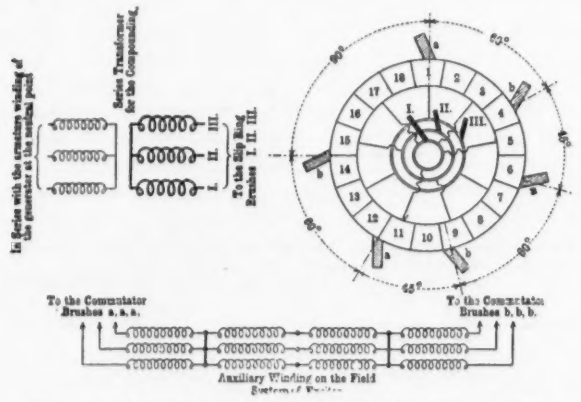

Series Transformer for the Compounding.
To the Slip Rings Brushes I. II. III.
To the Commutator Brushes a, a, a.
To the Commutator Brushes b, b, b.
Auxiliary Winding on the Field

FIG. 4.—CONNECTIONS OF COMMUTATOR FOR EXCITER.

help of slip rings. Fig. 4 shows the actual connections for the compounding commutator of a six-pole exciter for a three-phase alternator. Had the latter been a single-phase machine, but two slip rings would be required. It is proposed to apply this method of indirect compounding especially to existing installations, compounded exciters being substituted for the present exciters.—Lond. *Elec.*, July 15.

Design of Transformers.—MÜLLER.—A mathematical article on the best design of transformers. He gives the following rules: The magnetic flux density in the iron cores surrounded by the coils should be 2½ times that in the yoke. For equal total losses and for given dimensions of a transformer the output, and therefore the degree of utilization of the active material, becomes a maximum if the Joulean heat losses are 24 per cent. smaller than the total iron losses.—*Zeit. f. Elek.* (Vienna), July 17.

REFERENCES.

Commutator Single-Phase Motors.—LEHMANN.—The conclusion of his theoretical paper on the theory of single-phase commutator motors. The author deals with the Winter-Eichberg motor and discusses the influence of magnetic stray fields on the operation of the compensated single-phase motor.—*L'Eclairage Elec.*, July 16.

Induction Motor.—HAHN.—A brief article discussing the return of power from a three-phase induction motor to the network when running above synchronism. The article seems not to contain anything new.—*Elek. Anz.*, July 3.

LIGHTS AND LIGHTING.

Electric Lighting.—HARDEN.—An article describing some recent developments in the electric lighting field. Besides the magnetite lamp of the General Electric Company and the mercury vapor lamp, an arc lamp of Blondel is described in which carbons are used containing cores impregnated with magnesium and fluorine salts. The impregnated core has a diameter about 80 per cent. of the total carbon diameter. The white vapors developed are condensed on a reflector. The lamp burns normally with 3 amp. continuous current, the positive electrode being below the negative. A 5-amp., 46-volt lamp gives about 1,200 candles; that is, about 0.2 watt is consumed per candle in the most favorable direction. A disadvantage is the short life, which is 8 to 9 hours. The light has a yellow color. Another disadvantage is that the lower carbon is covered with slag and the lamp is then extinguished; it must then be cleaned. Two lamps may be used in series at 110 volts.—*Elek. Anz.*, June 30.

POWER.

Boiler House Economics.—DOWNE.—A (Brit.) Mun. Elec. Assoc. paper, in which the author recommends that a rigid weekly analysis should be made of the units generated, together with the coal and water used. In taking the latter he has found watermeters unreliable after a few weeks' continuous running, and has recently employed two measuring tanks instead. To encourage careful stoking, he has introduced a bonus system for firemen. The bonus is divided between the four leading firemen, and has been fixed at 25 cents per week for each tenth of a pound of coal saved below 6.5 pounds per unit generated during the summer months and below 5.5 pounds per unit during the winter months. Superheating is another means to economy, and the author has superheaters fixed in the downtakes of all his Lancashire boilers, and has been able in this way to raise the temperature of the steam leaving the superheaters by 80° F. to 150° F. Tests on one of his 250-indicated-hp Musgrave-Corliss condensing engines supplied with steam from a 7-ft. by 28-ft. Lancashire boiler with and without a Musgrave superheater showed a saving of 17 per cent. in water and 16 per cent. in coal with a superheat of 85° F. The author does not think that mechanical stoking conduces to much saving, but, on the other hand, is impressed with the advantages of forced draught. He apparently attaches more importance to avoiding a change in the class of fuel than to carrying out frequent analyses of it, but recommends the employment of a CO_2 recorder to keep a close watch on air leakages. Figures given in the paper show the value of investigations made in this direction in the author's own station. In concluding his paper he expresses his opinion that it should be possible by improvements in the design of boilers to raise their thermal efficiencies considerably.—Lond. *Elec.*, July 8.

REFERENCES.

Electric Cranes.—WARR.—An illustrated article on the electrical equipment of overhead traveling cranes with separate motors for each motion. The author gives an explanation of the electrical equipment, with drawings of the wiring and switches, etc.—Lond. *Elec. Rev.*, July 15.

Electric Hoists.—A fully illustrated article pointing out the advantages of the electric type of hoists, and describing their development and use for deep hoisting in America, Germany and South Africa.—*Mines & Minerals*, July.

TRACTION.

Railway Power House Switchboard.—A continuation of the long illustrated description of the Carville power house supplying current to the North Eastern Railway. In the present installment the switch gear is described. In an editorial note on the subject it is said that

an ordinary oil switch, rated from 50 to 100 amp., 6,000-volt, three-phase, and having all three poles in one oil tank, is, if carefully designed, an excellent piece of apparatus when placed at the end of the feeder supplying transformers or rotary machinery on an ordinary power or lighting load. But with the large generating units at Carville a switch designed on these lines would be unsuitable, owing to the fact that it must open on a heavy fault with the whole power of the station behind it. Especially is this the case when, as at Carville, a railway is to be supplied on which heavy short-circuits occasionally occur. The Carville switch gear and connections for the various units and for the outgoing circuits are kept as separate from each other as possible; the different phases of each circuit are separated; the connections are thoroughly fire-proof; each portion of the switch gear is arranged so that it can, in case of breakdown, or for the purpose of overhauling, be isolated from the rest of the apparatus; provision is made for easy extensions of the switchboard. Since it was necessary that the circuits should all run parallel to each other and perpendicular to the bus-bars, and the bus-bars themselves had to be absolutely safe, the switchboard involves considerable amount of space, occupying an entire side of the engine room.—Lond. *Elec.*, July 8.

Interurban Electric Railway.—An illustrated description of the Springfield, Troy & Piqua electric railway, which is a 31-miles interurban freight and passenger electric line in Ohio. The power station is located at the Springfield end of the line instead of at the center, owing to the exceptional facilities for securing water and fuel at that point, as well as to the likelihood that future railways running from Springfield will secure power from this station. The station contains four 300-hp boilers and two 850-hp cross-compound, high-pressure condensing engines, having intermediate receivers. The main generators are direct-connected to the engine shafts and are of the revolving-field, three-phase, 25-cycle type, running at 94 r.p.m. They are rated at 540 kw and deliver 845 amp. at 370 volts. Two sets of step-up transformers are used, one for transforming the generator e.m.f. to 26,400 volts for transmission to the company's sub-stations and another set for transforming to 6,600 volts for transmission to the sub-stations of another company. To provide for possible multiple operation, the transformers are made interchangeable for either voltage. About 11 miles of the road are fed direct from a 300-kw, 600-volt, rotary converter installed in the power house. There are two outside sub-stations.—*St. R'y Jour.*, July 23.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCES.

Electricity Supply in Mirfield.—A note stating that the municipal authorities of Mirfield (a small town in England) have decided to buy their electricity "in bulk" from the Yorkshire Electric Power Company, instead of erecting a generating station. The municipality will deal with the lighting supply only and has left to the power company to deal with the large users of power directly.—Lond. *Elec.*, July 8.

Ladysmith.—An illustrated description of the electric lighting plant at Ladysmith, Natal. It contains at present two steam dynamo sets, each of 50 kw. The distribution is on the three-wire system, with 400 volts between the outers.—Lond. *Elec. Rev.*, July 8.

ELECTRO-PHYSICS AND MAGNETISM.

Alloys of Iron.—BARRETT.—An account of a long series of investigations of the electric and magnetic properties of alloys of iron. The curves in Fig. 5 exhibit the resistivities or (specific electric resistances) of various alloys. Each curve corresponds to an alloy of iron and one other element, the name of the latter being attached to the curve. The percentage of the added element is plotted horizontally, while the resistivity of the alloy, in microhms per cubic centimeter at 18° C., is plotted vertically. The three horizontally-broken lines near the bottom of the figure indicate the resistivities of iron when the impurities contained amount to 1 per cent., 0.5 per cent. and 0.1 per cent., respectively. The increase in the resistivity is not directly proportional to the percentage of an element added to pure iron; the first increment produces by far the greatest effect. The presence of carbon in composite alloys of iron has a marked effect on the resistivity. The curve marked *Mn* refers to a manganese alloy rich in carbon, while that marked *Mn* (low C) refers to an alloy poor in carbon. Fig. 6 gives the permeability for a number of alloys.

The curve for nickel is particularly noteworthy. A small percentage of nickel scarcely affects the permeability, but if the percentage added

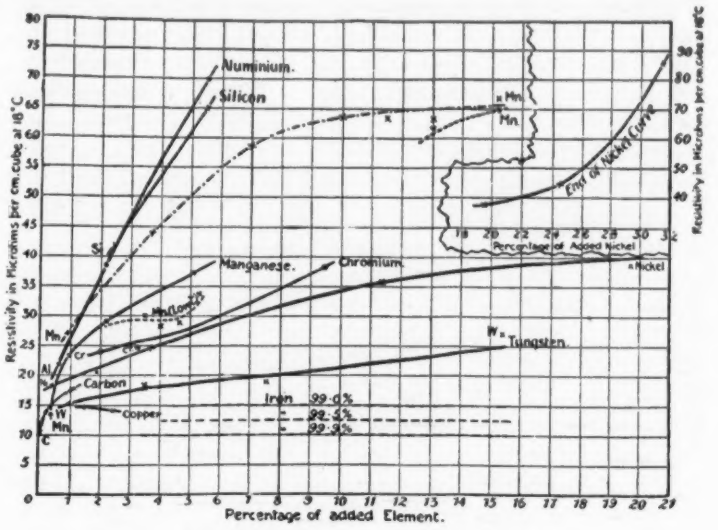


FIG. 5.—RESISTIVITIES OF ALLOYS.

is increased a certain fall in the permeability occurs when about 4 per cent. is reached, the alloy then becoming very feebly magnetic. A further increase in the percentage of added nickel produces little effect until about 25 per cent. has been added, when the permeability rises somewhat rapidly. Annealing produces marked effects on the permeability of iron alloys. Thus an alloy containing 8.9 per cent. of chromium and 3.1 per cent. of manganese is highly magnetic when annealed, but practically nonmagnetic when unannealed.—*Iron & Steel Magazine*, July.

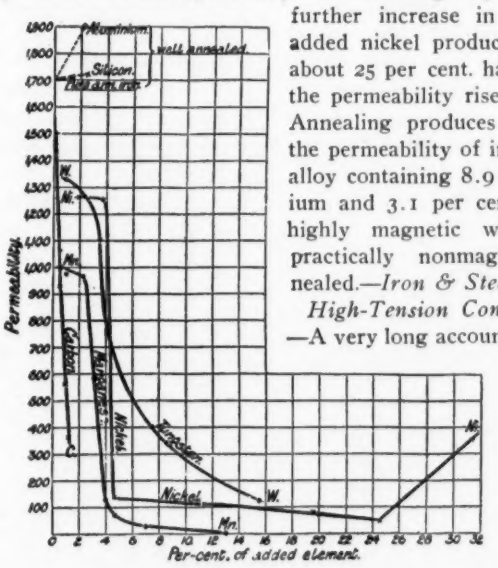


FIG. 6.—PERMEABILITY OF ALLOYS.

High-Tension Condensers.—MOSCICKI.—A very long account of tests made with high-tension condensers. He prefers the tube form to the plate form, since with the tube form it is possible to use glass of very small thickness. Glass of 0.5 mm. thickness stands voltages up to 67,100, except at the rims, where the same thickness of glass is perforated by 11,700 volts. To prevent perforation at the rims it is only necessary to thicken the walls of that part of the dielectrics on which the rim of the condenser plate is placed. This may easily be done if the condenser is made in tube form. Another advantage is that the condenser very quickly cools off. By proper insulation it is possible to cause the influence of surface conduction and of silent discharges to disappear altogether. In this way the efficiency of the condenser is considerably increased. With alternating current of the usual frequency of 50 periods per second, the losses were found to be less than 1 per cent. The author has made a long series of tests as to the strength against perforation and as to the losses. Concerning the latter he finds that with constant frequency and constant thickness of dielectrics the losses increase with increasing voltages; they are not proportional to the square of the voltage (Steinmetz) nor to a power of the voltage smaller than 2 (Arno and Threlfoll), but to a power of the voltage greater than 2. For the same kind of glass, with constant voltage and constant frequency, the percentage losses decrease with increasing thickness of the glass, but the law of the decrease is not yet known. For constant voltage and constant glass thickness the percentage losses increase with increasing frequencies.—*Elek. Zeit.*, June 23, 30.

Thorium Emanation.—LE ROSSINGNOL AND C. T. GIMINGHAM.—An account of experiments as to the rate of decay of thorium emanation. The time taken to decay to half value was found to be 51 seconds.—*Phil. Mag.*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Treatment of Zinc Sulphides.—BURLEIGH.—An account of experiments in which various ores were treated by an alkaline solution which was electrolyzed and the lead plated out completed, after which, in another set of cells, most of the zinc was plated out and the solution again turned on fresh ore, where it was once more enriched by lead and zinc dissolved from the fresh ore. Voltage used in the lead cells varied from 1.5 to 1.8 per cell, the average being 1.6. In the zinc cells the voltage may vary between 2.25 and 7 volts per cell, using a varying current of from 8 to 200 amp. per square foot of cathode surface. After several continuous runs, some 5 or 6 months long, the solution was not vitiated, although several different ores were treated, some containing arsenic and manganese.—*Eng'ing & Mining Jour.*, June 2.

Electrolytic Oxygen and Hydrogen.—An illustrated description of the Hazard-Flamand process in which the oxygen and hydrogen gases produced by electrolysis are kept separated by a series of gutters of insulating material, provided between anode and cathode, one above the other, thus permitting the passage of the electrolyte from the anode to the cathode, but preventing the gases from mixing. With 2.1 volts at the voltameter terminals, the yield of oxygen per kw-hour is 141.7 grams, giving a watt-hour efficiency of 66 per cent.—*Electrochem. & Met.*, June.

Very Small Ionic Concentrations.—HABER.—A paper pointing out difficulties in the conception of such very small ionic concentrations as have sometimes been calculated from e.m.f. measurements by means of Nernst's formula. The assumption of the existence of such small concentrations of ions appears to conflict in some cases with the atomic theory.—*Zeit. f. Elektrochemie*, July 1.

Electrometallurgy of Iron and Steel.—NEUMANN.—The first part of a long, critical review of various electric furnace processes proposed for use in the iron and steel industries. The processes of Ruthenburg, Siemens, De Laval, Stassano, Conley, Heroult, Keller, Harmet, Kjellin, Gin and Girod are described.—*Stahl und Eisen*, June 15 and July 1.

Edison Battery.—A fully illustrated description of the Edison storage battery as exhibited in St. Louis.—Lond. *Eng'ing*, July 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Capacity.—ROSA AND GROVER.—An abstract of a Phys. Soc. paper on absolute measurements of capacity made at the National Bureau of Standards. Maxwell's bridge method was used, with a rotating commutator in the fourth arm of the bridge for charging and discharging the condenser. A special feature of the commutator consisted in two contact brushes, through which the charge and discharge took place, so arranged as to afford air insulation when the brushes were not in contact with the metal segments and to prevent any appreciable leakage across the bridge arm. The commutator was driven by a large electric motor, which received current from a storage battery, and the speed was maintained constant by means of a carbon rheostat in the armature circuit of the motor. The criterion of uniform speed was the balance of the bridge, which was indicated by zero deflection of the galvanometer. It was found possible to maintain speeds more easily constant in this manner than when using a stroboscope method with a tuning fork. The exact average value of the speed was determined by registering every fiftieth revolution of the commutator on a chronograph cylinder by means of an electric contact. Another paper by the same authors gives the results of tests of a greater number of mica condensers. They measured the change of capacity with the time of charge, the magnitude of its absorbed charges and its leakage resistance. The order of magnitude of the latter for the best condensers was as follows: For a capacity of 0.1 and 0.2 microfarads the leakage resistance was 2,120,000 and 1,500,000 megohms, respectively.—*Phys. Rev.*, July.

Measuring Inductance.—ROSA AND GROVER.—An account of absolute measurements of inductance carried out in the National Bureau of Standards. The method used was originally proposed by Joubert. It consists in joining a non-inductive resistance in series with the inductive resistance to be measured and passing an alternating current through them. An electrometer is then connected so that it may measure successively the difference of potential at the terminals of the inductive resistance and the non-inductive resistance, and the latter is varied until the two readings of the electrometer are equal. The current and voltage being the same for each, it follows that the impedance of the inductive resistance is equal to the resistance of the non-inductive resistance. The inductance of the former can then be calculated when the frequency of the current and the resistance of the inductive coil are known. The frequency is determined in the same manner as when measuring capacity absolutely, namely, by recording every fiftieth revolution of the generator on a chronograph. To keep the speed constant a condenser is joined up to a Wheatstone bridge, and the galvanometer deflection is kept zero by hand regulation of the motor current. In other words, the condenser experiment is here used as an auxiliary to the inductance measurement. If the wave form is not a true sine curve (as it never is), it is necessary to apply a correction to the result, computed on the assumption of a sine wave, and the value of this correction depends on what harmonics are present and on their relative magnitudes. If the harmonics are very small, the correction is also small.—*Phys. Rev.*, July.

Demand Indicator.—DICK.—An illustrated description of a new demand indicator for "supply in bulk" schemes, charging according to the maximum demand system. The problem is here different from that in a system supplying energy for lighting. For power purposes, the instrument should be more sluggish and the registration of accidental peaks which do not appreciably affect the generating plant should be avoided. An instrument peculiarly suitable for this purpose has been devised by Merz. It is arranged so as to integrate the load curve during a given period, then to be reset to zero and to repeat the process of integrating the next time element of the load curve. Certain momentary high peaks thus appear only in the average value of the period, for instance one hour, for which the instrument is set. Merz's apparatus is an auxiliary attachment to an ordinary motormeter, either ampere-hour or watt-hour. Its chief parts are a pointer driven by the meter train, an indicating dial and a clock for periodically resetting the driving mechanism to zero. The first wheel, *A*, of the mechanism (Fig. 7) is geared to a convenient part

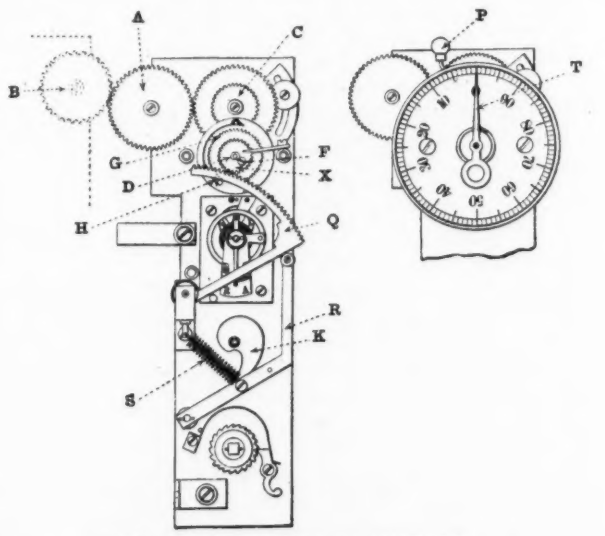


FIG. 7.—MECHANISM OF INDICATOR.

of the ordinary train, *B*, and, by means of a suitably chosen ratio wheel, *C*, turns a spindle, *D*, through a given angle in the period between each resetting to zero. The ratio wheel is so selected as to give nearly a complete revolution of the pointer should full load be maintained on the meter for one hour. This driving spindle serves to turn a sleeve on the same axis through the medium of a simple form of clutch, usually a ratchet, *G*, and pawl, *H*. A toothed wheel on the sleeve carries the driving pin, *F*, which actuates another pin on a toothed disc, mounted on the same spindle as that to which the pointed is attached. A little pawl on the tooth disc retains the pointer, *T*, in its maximum position and prevents it being reset to zero by the automatic action of the mechanism. At the end of each month the meter reader does this simply by releasing the pawl and pushing the pointer back to its zero stop. The tooth wheel, *X*, on the sleeve gears with a rack in the form of a quadrant, *Q*, which is, of course, moved through a certain angular distance with the movement of the meter. At the end of each hour it is pushed back to its initial position, carrying with it the toothed wheel and driving pin by a resetting arm, *R*, on the clock. This arm in its turn is actuated by a spring, *S*, and the cam, *K*, forming part of the clockwork, the

cam releasing the arm and spring every hour. The clock, which usually goes for eight days, is so arranged that it always keeps the resetting arm just a little ahead of the fastest possible movement of the quadrant, so there is no friction whatever between the recording and resetting parts of the mechanism.—Lond. *Elec.*, July 1.

Central Station Meter Department.—CRIDGE.—An abstract of a paper read before the (British) Mun. Elec. Assoc. on the organization and management of a central station meter department, the meters being single-phase. A 10-kw transformer supplies the current for testing, the arrangements being such that a large current at low pressure is passed through a number of meters in series, while the pressure coils of the meters are supplied from a separate pressure circuit. This means considerable saving over the method still frequently employed for testing meters with their actual full load. The number of revolutions of the meter disc are timed, the maker's figures for the gear ratio being accepted.—Lond. *Elec.*, July 1. The complete paper, with a full account of the discussion which followed, is given in Lond. *Elec.*, July 8.

REFERENCES.

Insulation Resistance.—SAHULKA.—An illustrated article on the use of the electrostatic voltmeter for determining the insulation resistance of cables. The author deals especially with the measurement of the insulation of two-wire and three-wire, direct-current systems, during operation and without interruption of service.—*Elek. Zeit.*, June 30.

Multiple Tariff Meter.—RASCH.—After some general remarks on the proper method for charging for electrical energy he thinks that a double-tariff meter represents some progress, but that a multiple tariff meter is still better. He describes the multiple tariff meter of Baumann and remarks that a meter arranged for eight different tariffs is scarcely more expensive than an ordinary double-tariff meter.—*Elek. Zeit.*, June 23.

Alternating-Current Instruments.—DUDDELL.—His full paper of some instruments for the measurement of large and small alternating currents, an abstract of which was recently noticed in the Digest. —*Phil. Mag.*, July.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Barretter.—REICH.—An account of some observations made with the Schlömilch wave detector for wireless telegraphy, which consists of a small cell with platinum or gold electrodes in dilute acid through which passes a slight current, so that there is just a slight development of gas at the electrodes. A galvanometer in the circuit indicates an increase of the current when electric waves reach the cell, and the increase is the greater the smaller the surface of the anode. In the instruments now built by a German wireless telegraph company the anode consists of a wire of 0.001 mm. diameter and about 0.01 mm. length. Form and length of the cathode do not play any essential part. The arrangement is quite similar to that of Fessenden's barretter. Fessenden explains the result as analogous to the action of the bolometer. The present author gives some reasons why he thinks the effect is due to depolarization of the anode.—*Phys. Zeit.*, June 15.

Wireless Telegraphy.—PFITZNER.—A long description, illustrated by diagrams, of the Telefunken system for wireless telegraphy, which has been developed by a German company on the basis of both the Slaby-Arco and the Braun systems. The author deals especially with Braun's method of using a number of oscillating circuits for increasing the energy sent out from the vertical wire of the transmitting station. He also describes a method for exactly determining small capacities, which had to be worked out on account of the use of condensers of very small capacity.—*Elek. Zeit.*, June 23.

Alarms.—An illustrated description of some new electric alarm devices.—*Elek. Anz.*, June 16.

Protection of Industrial Property.

A dispatch from Berne, Switzerland, of August 1 says: "Nineteen States, including the United States, are represented at the International Conference on Industrial Property, which opened here to-day. The conference will discuss the unification and simplification of regulations relating to industrial property in different countries. Mr. P. G. L. Webb, chief clerk of the Patent Office at Washington, represents the United States."

New Books.

ESSAIS INDUSTRIELS DES MACHINES ELECTRIQUES ET DES GROUPES ELECTROGENES. By F. Loppe. Paris: Gauthier-Villars. 280 pages, 129 illustrations. Price, 8 francs.

This volume, already briefly noted in these pages, is based on lectures of the author delivered to students of the École supérieure d'Electricité de Paris, and the title may be translated as "Commercial Testing of Electrical Machines and of Electric Generating Sets." The author, after discussing the relative advantages of various devices for determining speeds, gives a description of the method for finding the friction by allowing the armature to come to rest from some higher speed. He then briefly but broadly discusses the various ways of using electrical instruments. Methods of loading generators by various forms of rheostats are treated in detail.

In Chapter II high-potential tests of the insulation are taken up and we recognize the familiar curve of spark-gap distances of the A. I. E. E. Increase of temperature in windings of machines as measured by increase in resistance is treated perhaps more briefly than this important subject warrants. A very interesting discussion of the relative accuracy of the direct method as compared with the loss method, for the determination of the efficiency in which the great advantage of the loss method is demonstrated, closes the chapter.

Chapter III treats of tests of direct-current machines, and the author considers methods for determining brush drop, and gives the results of some European tests. The various characteristics of generators and motors are thoroughly and very clearly treated. Methods of obtaining efficiency are taken up in turn, the following being considered, by substitution, by separate determination of the losses, which is illustrated by an example, and the motor-generator methods. Especially in his treatment of the loss method is the author to be commended for the lucidity and thoroughness with which he treats his subject.

In Chapter IV we pass to the subject of alternating-current apparatus, and peculiarly the author again introduces the subject of brush drop. The resistance of three-phase windings and the measurement of power in three-phase circuits are discussed, the latter being treated somewhat too briefly. After a short description of various methods of obtaining the shape of the alternating-current wave, the author passes on to the subject of regulation and describes the well-known methods of Dr. Behn-Eschenburg (e.m.f. method) and of Rothert (m.m.f. method) for the determination of this quantity. He agrees with the majority of engineers that neither is very satisfactory and cites a method of Potier which involves the determination of the open-circuit saturation curve, the short-circuit curve and one point of the load saturation curve at low power factor. This method is developed theoretically and illustrated by an example, but appears rather complicated. Tests on synchronous motors are briefly treated and then tests on induction or asynchronous motors are taken up with the aid of the Heyland diagram, which the author states is only approximate for large motors. As a matter of fact, the diagram is only approximately correct for all motors, but is by far the simplest way of treating the various problems of the induction motor. Under transformers the author gives the various tests, and as usual with European engineers, gives the Kapp diagram for finding the regulation, which neglects the large influence of the magnetizing current upon the regulation. Various methods of calculating the efficiency of diverse alternating-current apparatus close the chapter.

In Chapter V the author discusses various tests made on steam and gas engines, the use of the indicator and calculation of the indicated power. The calorific value of various fuels and methods for determining the same are given in detail and the chapter is concluded with methods for determining hydraulic power. This chapter could, with advantage, have been omitted, as such subjects are more fully treated elsewhere.

Chapter VI is an appendix with several tests that had been omitted from preceding chapters, and in Chapter VII, which is the last, we have the report of the Committee on Standardization of the A. I. E. E., the rules of the "Verband Deutscher Elektrotechniker," both in French translation, and the rules of the "Association Française des Propriétaires d'Appareils à Vapeur."

The book is well printed, and the generosity of diagrammatic sketches to illustrate methods of testing is to be commended. Outside of a few lapses from a logical arrangement, the general plan

of the work is well thought out, and like most French scientific works, the style is very clear, concise and to the point. Perhaps a fault may be found in the scarcity of actual examples, which are really necessary in a practical work on testing, but the book can be strongly recommended to those interested in the subject of testing.

New Westinghouse Instruments of Precision.

In order to bring the standardization of electrical instruments to a place in keeping with its importance, the Westinghouse Electric & Manufacturing Company has developed a line of instruments of precision which combine the accuracy of the best-known standards with the portability and rapid manipulation of the testing instruments now in vogue. The advantages of both types have been retained, with

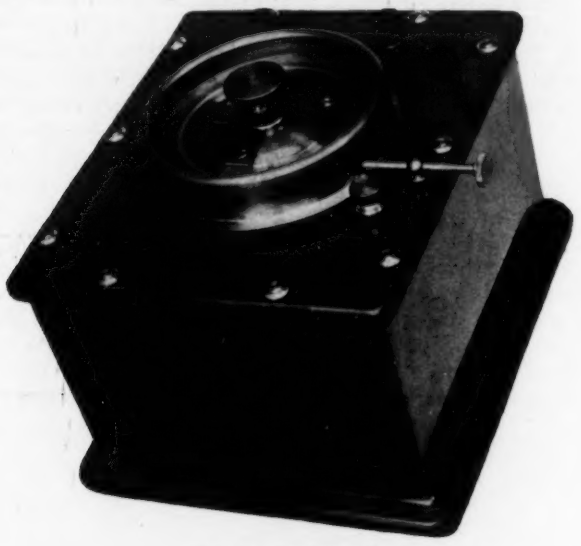


FIG. 1.—VOLTMETER.

the elimination of those features which detract from their value in general use.

Having provided instruments of superior quality, the Westinghouse Electric & Manufacturing Company proposes to secure to purchasers a continuation of their initial accuracy by keeping them in calibration for five years without charge. All the facilities of the Westinghouse Department of Standards are placed at the service of possessors of these instruments of precision so far as may be neces-

FIG. 2.—AMMETER.

sary to keep them accurate. Special shipping cases are provided to minimize the labor of packing and shipping. At any time within the period named, customers may ship these instruments to the Westinghouse Department of Standards to be checked, and the work will be done promptly, with no cost to the owners except that of carriage. By first providing instruments which fulfill perfectly the needs of the laboratory and testing room, and then by insuring their continued accuracy, all the present trouble with the checking of standards is eliminated and a new system for their care is inaugurated.

The illustrations (Figs. 1, 2 and 3) show the voltmeter, ammeter

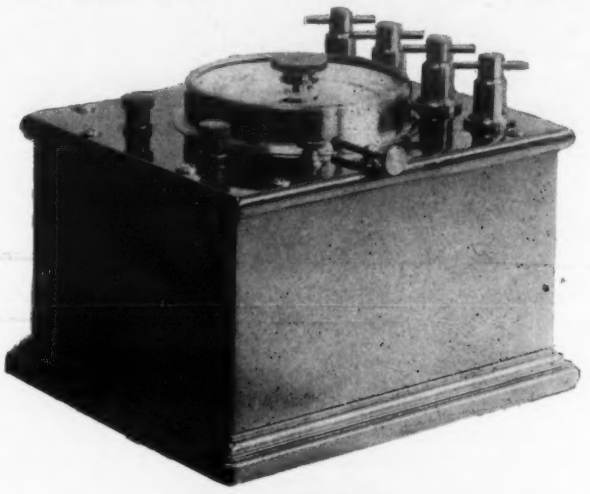


FIG. 3.—WATTMETER.

and wattmeter. The cases of the instruments are of polished mahogany, with all exposed parts finely finished. The mechanism is mounted in a cast frame made of a high resistance alloy, and suspended from the top plate. This is made of black enameled slate, giving a rigid construction and not affected by warping or changes in temperature. In principle, these instruments operate on the mutual attraction between two systems of movable and stationary coils placed in inductive relation to each other, the two systems of coils being so arranged as to neutralize the mutual induction and the effect produced by any external field. The readings are thus equally accurate with direct and alternating currents, and there is no necessity for reversing the readings on direct currents as with ordinary standards.

The controlling force is very large, rendering negligible any friction effects, and presenting in this respect a strong contrast to the

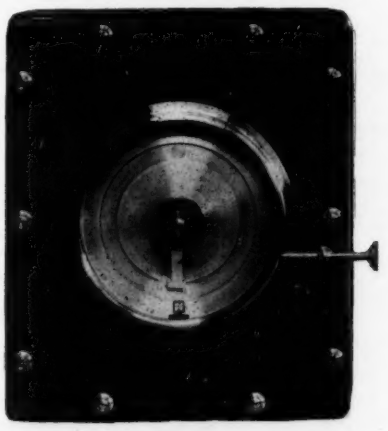


FIG. 4.—VOLTMETER DIAL.

ordinary standards, in some of which the controlling force is so slight that the static attraction produced by rubbing the glass over the dial will introduce an error.

The voltmeter dial, illustrated in Fig. 4, shows the general form used in the different instruments. The scale is accurately graduated upon a five-inch circle, all the divisions being uniform and thus equally legible over the entire range. By means of the vernier, tenths of a division may be read, giving a range of 2,000 readable divisions, greatly exceeding the readable range of any other standard instrument in general use. The sight wire is shown in a square frame, which is attached to the movable system. When current passes through the instrument the sight wire is carried to the right of zero. By means of a large knob the vernier is turned to the left until the sight wire is approximately upon zero, a fine adjustment being obtained by the knob upon the right. The two rubber-covered voltage terminals are also seen, with the stop for holding the movable element in a fixed position when the instrument is not in use.

The voltmeter and ammeter dials are similar. The inner gradua-

tions are so spaced that their value is proportional to the square root of the deflection, allowing readings to be taken direct, without calculation. When readings of fractional parts of divisions are required, the outside scale with the vernier may be used and the corresponding value of the reading on the inner scale determined from the table of square roots furnished with each instrument. In the wattmeter there is but one set of graduations, similar to those shown on the outer circle of the voltmeter scale.

A resistance or multiplier is used in the potential circuit of the voltmeter and wattmeter. The potential coils of the instruments are adjusted to a uniform resistance of 100 ohms, and the external resistance is subdivided so as to give total values of 1,000 ohms or multiples thereof. When in use a resistance of 1,000 ohms is employed for each 100 volts nominal potential. The resistances are accurately checked, and thus form standards of resistance as well as measuring instruments. As the same values are used for both voltmeter and wattmeter, one resistance will answer for both instruments.

The facilities afforded for accurate observation are worthy of special mention, and perhaps can be best appreciated by comparing the fineness of the sight wire with the width of the pointer in the ordinary standard instruments; the narrow, even, machine-cut division lines of the scale with the hand-drawn, irregular lines of other instruments, and the open divisions of uniform length giving equal legibility at all points with other scales, the end divisions of which are little if any wider than the lines which divide them or the pointer that indicates the reading. This superiority, which is readily apparent, extends as well to other parts of the instruments and to the design upon which they are constructed. They are in every way fitted for the checking of electrical metering devices and the accurate measurement of electrical quantities, while the free calibration insures the perpetuation of their accuracy.

Wireless Telephony at the St. Louis Exposition.

The discoveries and developments in wireless telegraphy have been so well exploited in public print that all which has been accomplished is well known and future improvements have been discounted by many large predictions. Regarding wireless telephony, much less is known, and so far it has been only a scientific toy, yet the two are somewhat closely allied. The telephone is used in one of the best sys-

FIG. 1.—PORTABLE APPARATUS FOR WIRELESS TELEPHONY.

tems of wireless telegraphy and the gap between the transmission of signals and articulate speech is a narrow one. Two different systems of wireless telephony have been installed in the Palace of Electricity at the World's Fair, one transmitting speech by the inductive effect of one conducting coil upon a secondary and the other transmitting sounds over a ray of light.

The first installation was made by Mr. M. R. Hutchison in the Court of the Palace of Electricity. Communication is accomplished by means of a transmitter, a battery, a primary loop, which confines the results within its scope, and a receiver attached to a secondary or exploring coil. When sound strikes the diaphragm of the transmitter, it is set in motion in correspondence with the different rates of the musical notes. This mechanical action of the diaphragm affects the resistance of the carbon particles of the transmitter and sets up an electric current in the primary loop corresponding to the motion of the diaphragm. The current flowing through the circuit creates a magnetic field of the entire space within the loop and about half of its diameter outside. The changing currents in the primary make

FIG. 2.—TRANSMITTING STATION FOR WIRELESS TELEPHONY.

changes in the lines of force corresponding to the original changes caused by the sound. These changing magnetic lines cannot be detected by the ear or even by the telephone receiver, and so an exploring coil is employed. Electric currents are generated in this secondary coil proportional to the variations in the magnetic field, and these acting upon the telephone receiver reproduce the sounds entering the transmitter. First a mechanical motion is produced which causes an electrical action affecting the primary circuit, then a magnetic field is formed which generates electrical current that sets the diaphragm in vibration, this completing the conversion of one form of energy into another. The exploring coil is about a foot in diameter and very small in comparison with the area of the magnetic field, so that but a small fraction of 1 per cent. of the energy in the primary circuit is exerted in the circuit of the exploring coil. Yet the transmission of the sound is as perfect as with an ordinary

FIG. 3.—RECEIVING STATION FOR WIRELESS TELEPHONY.

telephone system. To the casual listener, who does not understand the principle involved, the result is not only entertaining but mysterious. Whenever the receiver is used within the court the music can be heard. It can even be carried into the building, and the sounds can be readily heard so long as it is within the limits of the magnetic field.

The radiophone permits one to talk over a beam of light by varying the intensity of the rays of the electric arc light. The radiophone apparatus exhibited to-day is quite different from Prof. Bell's apparatus exhibited at the Columbian Exposition at Chicago in the

year 1893, both in regard to the transmitting and receiving station instruments. The transmitting apparatus exhibited at Chicago was an ordinary arc lamp, the rays of which were condensed by a suitable lens upon a circular mirror about 4 in. in diameter. By this mirror the beam of light coming through the lens was reflected to the receiving booth, and here, by a parabolic reflector, it was focused upon a small glass tube containing carbon in the form of lampblack. To this glass tube a rubber tube was connected, and from this lead two smaller rubber tubes to convey the sound to the ears.

A person talking into a mouthpiece at the back of the mirror at the transmitting station caused the mirror to vibrate, and these vibrations affected the beam of light in such a way that it caused similar vibration in the carbon in the glass bulb at the receiving station and upon which it was focused, and this, in turn, caused corresponding vibrations in the air in the bulb, reproducing speech.

The transmitting station at St. Louis is located at the north end of the Palace of Electricity, Block No. 1, on an elevated platform, which is about 14 ft. above the floor. On this platform is mounted a standard searchlight with horizontal carbons and a 13-in. reflecting mirror. The transmitter is bridged around the arc of the searchlight, which is supplied with a current of about 20 amp. at a pressure of 100 volts. The transmitter circuit is so adjusted that the maximum current which flows through the transmitter is about 5 amp. The transmitter is of the solid-back type, having platinum electrodes instead of the carbon electrodes usually used in transmitters of this style. A person talking into the mouthpiece of the transmitter influences the electric arc of the searchlight, thereby causing the intensity of the beam of light to vary. It is this variation that affects the selenium cell and causes its resistance to change.

The receiving station is located at the American Telephone & Telegraph Company's exhibit, Block No. 17. The receiving apparatus consists of a General Electric 30-in. searchlight reflecting mirror, at the focal point of which is mounted a selenium cell placed in series with a battery of dry cells and four receiving telephones. The selenium cells contain a cylinder of pipestone, on which is placed a double winding of brass wire. The wire is fastened to the cylinder by being forced into double threads cut in the pipestone for this purpose. The convolutions of each wire are separated from one another by the threads of the pipestone, this separation being about 1/64 of an inch. The brass wire is then treated with selenium by having a quantity of this element fused upon its surface. It is pertinent to state that selenium is a non-metallic element obtained as a dark brown, vitreous, amorphous modification or as a lead-gray, crystalline mass, noteworthy for its variations of electrical resistance under the influence of light and heat. The fusing point of selenium is about 217° C. or 425° F.

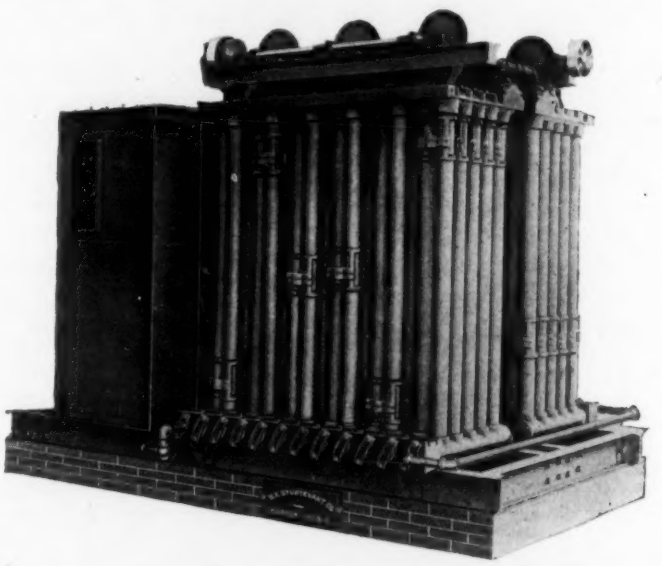
The pipestone cylinders are sealed in glass tubes and are mounted very much the same as is the standard incandescent lamp. The electrical resistance of the selenium cells very greatly, the range of resistance being from 10,000 and 30,000 ohms. The sound waves produced in the air by the speaker at the transmitter station are transformed by the telephone transmitter and the electric arc into light waves. These light waves are transmitted as such to the receiving station, where the process is reversed, and they are retransformed, through their effect on the selenium, into sound waves by the receiving telephones. The distance between stations is about 450 ft. Before sending this radiophone apparatus to St. Louis the engineer made tests on a range of three miles. It was found that the results were very satisfactory; in fact, the transmitter on this range was about 25 per cent. better than on a shorter range of about 1,500 ft. It is claimed that with this apparatus and suitably elevated stations that it would be possible to talk over a range from 8 to 10 miles.

Sturtevant "Standard" and "Pony" Types of Economizers.

In steam production in power plants, the use of mechanical draft enables a notable saving to be made through insuring a lower temperature of rejected gases, by transferring their heat to the feed water through the medium of an economizer. It follows, then, that the economizer in conjunction with mechanical draft reduces the coal bill to a minimum. To meet all conditions existing in power plants a great variety of economizer sizes are necessary. In order to make this flexibility possible, the sections of the Sturtevant economizer contain an odd as well as an even number of pipes, from four to twelve inclusive; thus four widths more are obtained than is possible by the use of sections containing an even number of pipes. The arrangement of pipes is a matter of great importance and divides economizers into two general classes.

To utilize the maximum amount of heat in the gases, the pipes of the Sturtevant economizer were designed to set staggered. Two sizes, similar in design, are constructed to meet all conditions: the Standard and the Pony types. The Sturtevant Standard economizer is installed in conjunction with boilers of almost any capacity, but is more practical for boiler capacities of 350 hp and over. The Pony type, illustrated herewith, was designed to give the smaller power plants the same proportional saving effected with the larger type. This is substantially the same as the Standard, excepting that the whole apparatus is built on a smaller scale. The Pony type is more commonly used with plants of from 50 to 500 hp capacity.

The importance of economizers in connection with steam production is not with respect to economy of coal alone. With the installation of economizers the contraction and expansion of the boilers are reduced to a minimum, due to the continuous feeding of extremely hot water at an even temperature; and the scale and deposits which greatly hinder the steaming are lodged with the econ-



PONY TYPE OF ECONOMIZER.

omizer before reaching the boilers. All this naturally lengthens the life of the boilers and lessens the expense of repairing and cleaning. Most important of all, however, is the fact that a saving of from 10 to 20 per cent. in the fuel is effected.

To agitate the gases and allow them to come into contact with the maximum area of the economized pipes, thus utilizing a maximum amount of the waste heat from the boiler, a system of staggered pipes was adopted. The several sections are so arranged that the pipes of any one section stand longitudinally opposite the spaces between the pipes of adjoining sections.

All caps have taper ground iron-to-iron joints, and can be easily removed at any time for cleaning. The caps directly over the pipes in the top headers are tapered, so that the greater the pressure in the economizer the more firmly the caps will set themselves. All the other caps are held in place by through bolts which clamp them tightly to the headers. The bolts do not come into contact with the water and therefore are not subject to the deteriorating effects from rust and other nuisances. Any pipe can be easily removed and another put into its place without disturbing the other pipes, sections or enclosing walls, as the joints are made taper iron-to-iron without any packing or cement. All pipes are cast on end and made of the best tough gray iron. Both ends are tapered and the pipes forced into the headers by hydraulic pressure, insuring perfectly tight joints. The wall box, as its name implies, is placed in the front side wall of the economizer, forming a part of the wall. The whole weight of the economizer, instead of being unevenly distributed on the foundations, is thus evenly distributed throughout the wall box surface. It is evident that perfect rigidity is assured with this arrangement. The headers are made of the best cast iron and designed with due regard to strength and durability. The bearing parts are properly machined and finished to gauges in order that

the taper joints may be perfectly tight and the headers exact duplicates.

The economizers are all provided with relief valves, which may be set at the desired steam pressure as a safeguard against too much pressure in the economizers. By means of the blow-off valves the soft deposits may be blown out, or the economizers may be emptied as desired. Cast-iron soot-pit doors are provided as a means of cleaning out the soot chamber. Before leaving the works each economizer is tested by hydraulic pressure to 350 pounds per sq. in., and when erected to 250 pounds pressure. This line of economizers is manufactured by the B. F. Sturtevant Co., Boston, Mass.

Telepherage in a Chocolate Factory.

The Walter Baker Chocolate Co. is one of the oldest and most successful manufacturing companies in this country. It has been established for more than a century and a quarter, and is noted for its successful and progressive business management. It has lately put in operation the telpherage plant here illustrated and described, for the purpose of conveying all of the cocoa beans used in its output, with other material, from the railroad storehouse to the new mill.

FIG. 1.—RIGHT-ANGLE CURVE AROUND RIVER BANK.

The former method was to truck all of this raw stock by a number of teams around the works by a circuitous route for a long distance, and then carry it up on elevators to the third floor of the mill.

This telpherage system was designed and installed to take the loads directly from the top floor of the railroad storehouse and convey them by the shortest possible route to the third floor of the mill, where the manufacture of cocoa and chocolate is begun, so as to reduce the cost of transportation of the raw stock to a minimum.

This route presented the most difficult conditions for the construction of the overhead track, but the distance between the buildings was reduced to the minimum. The only piece of level ground that the track follows is for 60 ft. beyond the railroad storehouse. It then turns a 90° curve of 40 ft. radius and passes along the side of a rocky, precipitous cliff, at the foot of which is a swift-running river. Another 90° curve of 20 ft. radius is then made, after passing over the roof of a building on the rocky ledge of the river bank, and then the track is carried across the river and 50 ft. above it on a steel bridge, erected under the most difficult conditions, into the third floor of the new mill.

On the level ground this portion of the track is supported by A bents 35 ft. above the ground, resting on concrete foundations. Along the rocky cliff the supports consist of high, vertical posts of Georgia pine 14 in. square, varying in length from 30 ft. to 40 ft. The foundations of these posts are cut out of the slanting side of the solid rock, and they are braced by heavy timbers in the shape of a figure 4, also anchored back in the solid rock. When one considers that the weight of one of these single posts is over a ton and a half alone, and the length is 40 ft., the difficulty of carrying them along the side of the precipice and standing them up on end can be appreciated. Although the United Telpherage Company has many plants in operation, nearly 75 in the Eastern States alone, this one is peculiarly interesting on account of the engineering difficulties. The whole plant was designed, installed and put in successful operation by the Telperage Company.

The track is nowhere less than 30 ft. from the ground, and nearly

FIG. 2.—TRACK ON STEEP CLIFF, FIFTY FEET ABOVE SURFACE.

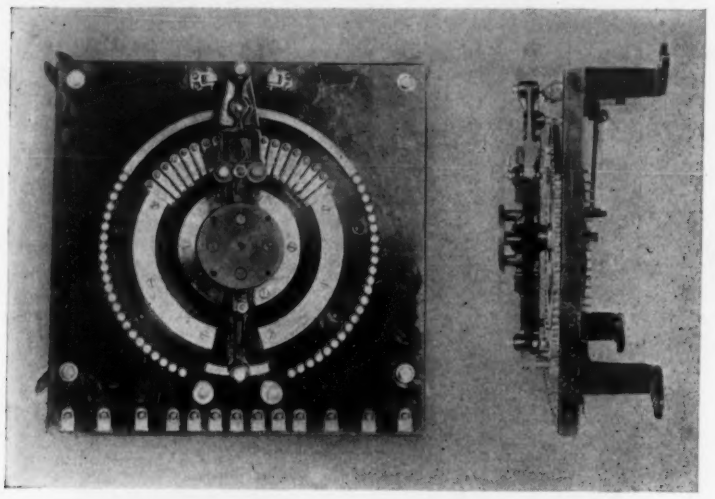
everywhere is from 40 ft. to 50 ft. above the ground or river, and is entirely free from being blocked by snow in winter, which is such a serious impediment to teams or any surface transportation. The bags of cocoa, weighing about 300 pounds each, are loaded on trucks in the railroad storehouse. Each truck has a capacity for 2,000 to 2,700 pounds. The loaded trucks are pushed underneath the machine

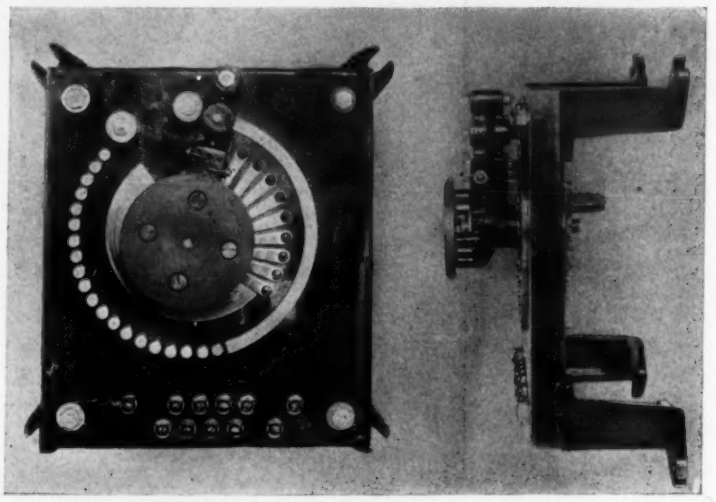
FIG. 3.—DETAILS OF TOWER TO SUPPORT STEEL BRIDGE.

and hooks are attached. The operator raises the trucks several inches clear of the floor, starts the telpher with its load of three trucks of 2,000 pounds each, and in three-quarters of a minute has passed by the cliff and across the river and has landed its load of three tons of cocoa beans on the third floor of the mill. The three loaded trucks are unhooked from the machine and pushed out of the way and three empty ones are hooked on in their place in less than a minute, and the operator is on his way back to the storehouse, where three more loaded trucks are awaiting him. The round trip has not taken three minutes. The cost of the power consumed by the telpher in running back and forth for ten hours a day does not amount to $1 for the day's work.

New Types of Controllers for Machine Tool Motors.

The rapidly-increasing application of individual motor drives to machine tools has brought into prominence the method of motor control in which the motor speed is varied entirely by means of change in the strength of the field magnet. This system of control is capable of wide application, due to its adaptability to installations already made, in which but two wires and a single voltage are available. A number of specil forms of controller have been developed to meet the requirements of this system, and among these certain apparatus now being placed upon the market by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., seems worthy of notice.





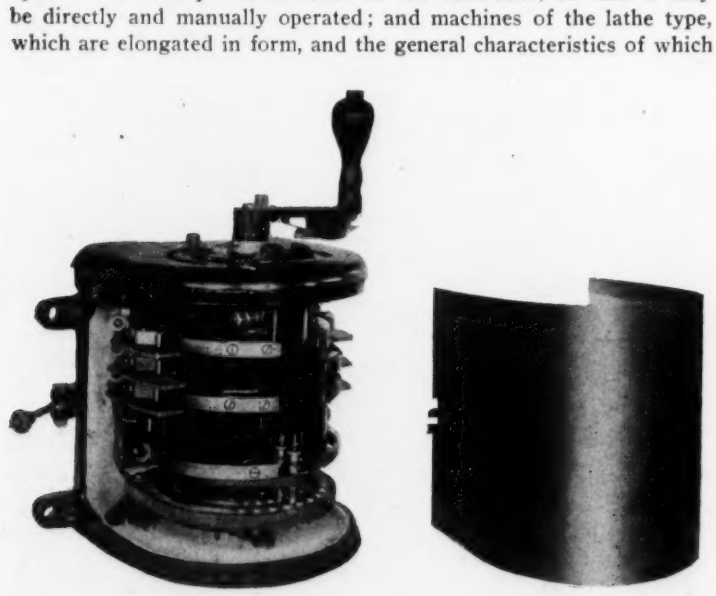
FIGS. 1 AND 2.—SLATE FRONT TYPE OF MACHINE TOOL CONTROLLERS.

In approaching the problem of controllers for this service the Cutler-Hammer Company considered the machine tools as being divisible into two general sections, namely, machines of the surfacing type, in which the general form of the tool is cubical, and the operator is usually within reach of the controller, so that it may be directly and manually operated; and machines of the lathe type, which are elongated in form, and the general characteristics of which prevent the location of the controller within direct reach of the operator.

The apparatus herein illustrated is intended for use with the second class of machinery, and is particularly adapted for operation at a distance by means of mechanical transmission. The controllers in question are of two types, namely, the slate front and the drum type, and each has its distinctive field of application.

The slate front type of controller (Figs. 1 and 2) is particularly adapted for mounting below the bed of a lathe, for instance, with the fibre disc shown attached to the lever projecting between the legs at the tailstock end. This fibre disc is attached to the control lever by means of four counter-sunk machine screws, and holes are provided between these screws forming an insulated attachment for a sprocket wheel. A similar sprocket is fixed on the end of the usual splined shaft device operated by the handle of the tool post, and these sprockets are so proportioned as to give the total required movement to the rheostat lever by the desired angular movement of the tool post handle. This provides for the cheapest form of connection, and, at the same time, for a simple and reliable device applicable through a wide range of service.

To meet conditions in which the slate front type would not be applicable, such, for instance, as in larger machines where the skeleton leg construction is replaced by closed pedestals, the drum type of controller (Figs. 3 and 4) has been designed. In general, these controllers are of ordinary construction, particular attention being given, however, to reduction of the length along the shaft, so that they may be mounted in horizontal position on the supporting pedestal without taking up too much room on the machine. This horizontal mounting makes possible the driving of the controller from the ordinary spline shaft arrangement by means of a pair of spur gears



FIGS. 3 AND 4.—DRUM TYPE OF MACHINE TOOL CONTROLLERS.

of proper ratio. The controllers are shown provided with operating handle; but as, in most instances, this will be replaced by gear, the usual three-square method of attaching the handle to the shaft has not been employed, but the handle is secured by means of a standard quarter-inch taper key, thus permitting it to be replaced by the operating gear with the minimum of expense and trouble. In addition to this the indicating pointer has been made separate from the handles, and remains in place after the handle is removed.

The apparatus being intended for use where wide ranges of speed variation by field change are obtained, a large number of field resistance points are incorporated, while the armature resistance points have been reduced to a safe working minimum. In both the slate

front and drum type controllers, on 110 and 220-volt service, 20 points of field control are provided, and on 500-volt service 18 points. The drum controllers have 4 points of armature resistance and the slate front type have 8. All armature contact parts are cheaply and easily renewable in both constructions, and without disturbing any connections in the case of the slate front type. In the case of the drum controllers, it is necessary to move connecting wires only when the contact fingers are to be replaced. This condition should not occur except at long intervals in ordinary service, and is, therefore, not considered detrimental. Blow-out magnets are provided at the breaking points on the slate front type in all sizes, and are provided where necessary in the drum type.

Effort has also been made to reduce to a minimum the labor of installing the apparatus electrically, and in the case of the slate front controllers the field resistance is mounted directly back of the slate, and consists of porcelain resistance units. Under these conditions it is, therefore, necessary to run only the armature and power lead wires and the leads to the armature resistance. In the case of the drum controller, the field resistance and armature resistance are mounted in the same framework, and the field connections to the drum are made in process of construction, the leads being brought out a distance of 3 ft. from the drum, thus eliminating the trouble inherent to making a large number of connections in the necessarily confined space permissible. Ample provision is made for connecting the armature resistance and power leads.

The apparatus is provided in both the reversible and non-reversible types, and in capacities up to 80 amp. on 220-volt circuit. The armature resistance is ordinarily arranged for starting duty only, although it is liberally proportioned, and should meet every requirement if not left in circuit continuously. Where it is desired that the resistance have continuous capacity this can be arranged for.

In cases where the application of this system of control is contemplated in connection with motors already installed, the motor manufacturer should be consulted as to the fitness of the motor for such service, as in most instances a special motor is required where wide speed variation is to be obtained by means of change in the field resistance.

Selective Ringing Keys.

The demand for party-line service combined with privacy consistent with the expense involved has led telephone manufacturing companies to produce selective apparatus remarkable in simplicity of construction and reliability of operation. Selective ringing keys have reached a degree of perfection scarcely surpassed or equalled by any other single part of modern telephone equipments. In Fig. 1

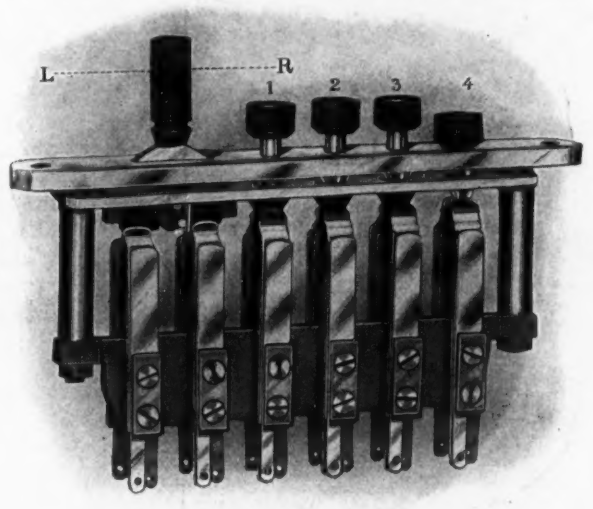


FIG. 1.—FOUR-PARTY LINE SELECTIVE RINGING KEY.

is shown one of the most recent designs of individual indicating keys intended for a four-party line, while a modification of this construction for use as a two and four-party master key is illustrated in Fig. 2. These keys are of the push-button indicating type, and both operate in the same manner as far as selection is concerned. The ringing on the key which is illustrated in Fig. 1 is done by means of a cam lever, which method has proved most efficient on party lines and permits having a four-party key with no more contacts in the talking circuit than in a regular metallic circuit ringing key. An examination of Fig. 1 will reveal the method of operation. Upon receiving a call the operator presses the cam lever into the listening position and selects the button corresponding to the number of the subscriber wanted, pressing it into the locking position (as shown at button No. 4). The button being depressed selects the proper ringing cur-

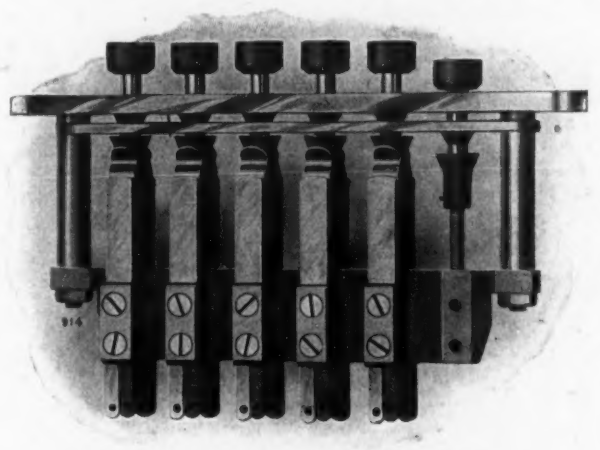


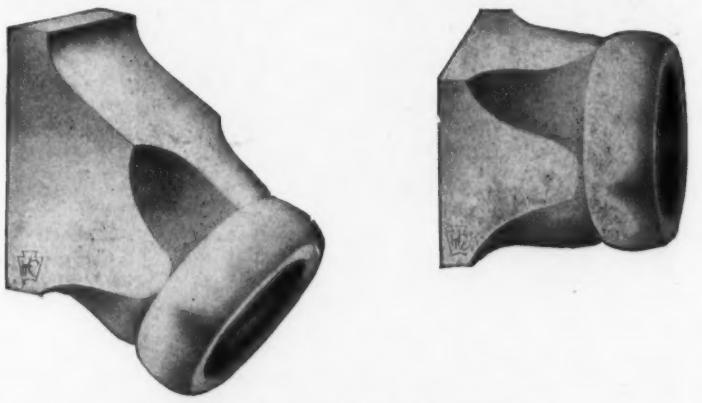
FIG. 2.—TWO AND FOUR-PARTY MASTER KEY.

rent and causes the cam lever to return to its normal position. The operator will then ring with the cam lever in the usual manner. The button will be automatically restored to its normal position when the cam is again thrown into the listening position or another button of the same set is pressed. In mechanical construction the key is substantially made and is quite compact, having an overall length of 5½ in. and width of escutcheon of ⅞ in.

For those who wish to install a number of party lines and already have a switchboard and regular cord equipment, the master key shown in Fig. 2 has been specially designed. It consists of five indicating push-button keys and one push-button release key. It is common practice to install a master key in each operator's position for selecting the proper ringing current, while the ringing is performed by the regular ringing keys. To ring a party on a line, the operator will first set the master key, then ring with the regular ringing key of the cord circuit in use. These master keys are uniform in size with the selective ringing keys, and show the same painstaking care in their construction. This line of telephone apparatus is built by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.

New Receptacles.

The H. T. Paiste Company, Philadelphia, Pa., manufacturer of the "P-K" goods, has recently added two new receptacles (Figs.



FIGS. 1 AND 2.—NEW LAMP RECEPTACLES.

1 and 2) to its well-known line of "fielding" receptacles. These it calls "show window fieldings," as they are specially well adapted for such display work. They have smaller bases than regular types, the straight style measuring only 1½ by 1½ in., while the 60° angle style has a base 2 by 1½ in. This permits wiring them much more closely together and thus obtaining stronger lighting effects.

The angle style holds the lamp and reflector at an angle that throws all the light on the articles making up the window display.

Sixty-Inch Roll Turning Lathe.

The accompanying illustrations present in a comprehensive way a heavy 60-in. motor-driven roll turning lathe, just built by the American Tool Works Company, of Cincinnati. In view of the extra heavy duty for which this lathe is intended, it is built extremely substantial throughout, which renders it capable of standing

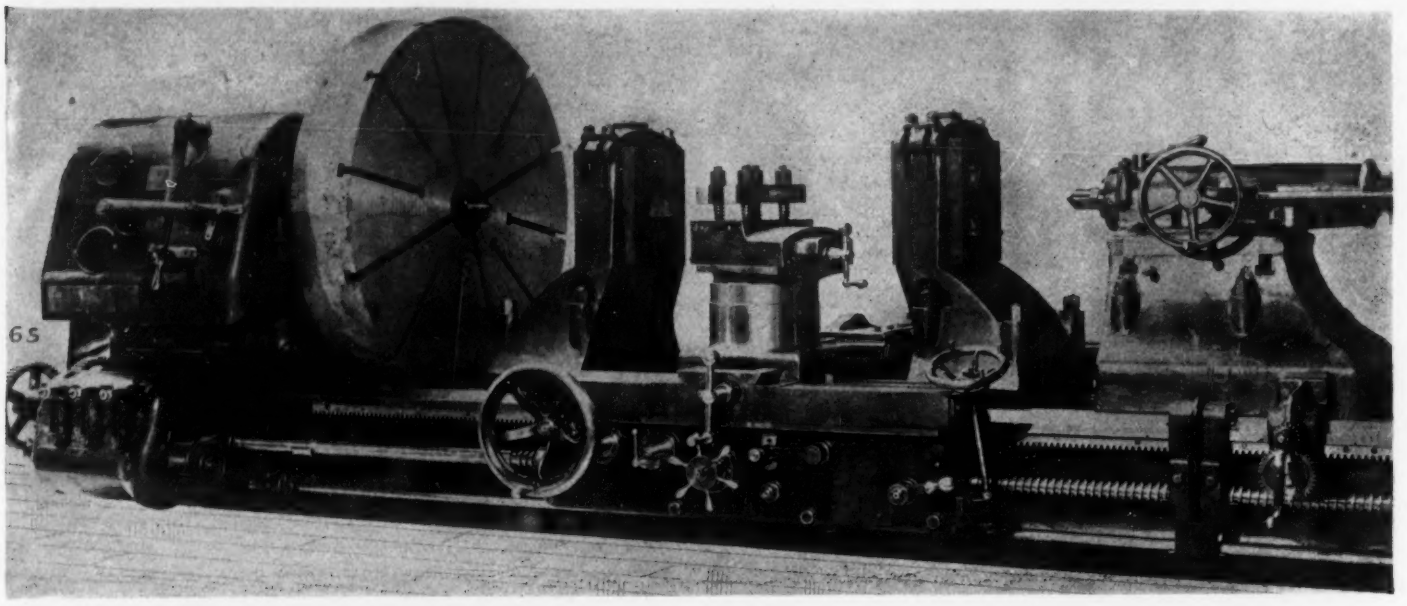


FIG. 1.—MOTOR-DRIVEN SIXTY-INCH ROLL TURNING LATHE.

up under the heaviest strains. The lathe is driven by a 25-hp variable-speed motor, which is mounted on a substantial stand at the rear of the headstock, and is connected to the driving shaft in the headstock by silent chain, as shown in Fig. 3. Primary speed variation is obtained electrically, through manipulation of the hand wheel, at the right-hand end of the carriage, which starts, stops, reverses the machine, and also varies the speed by minute increments. These

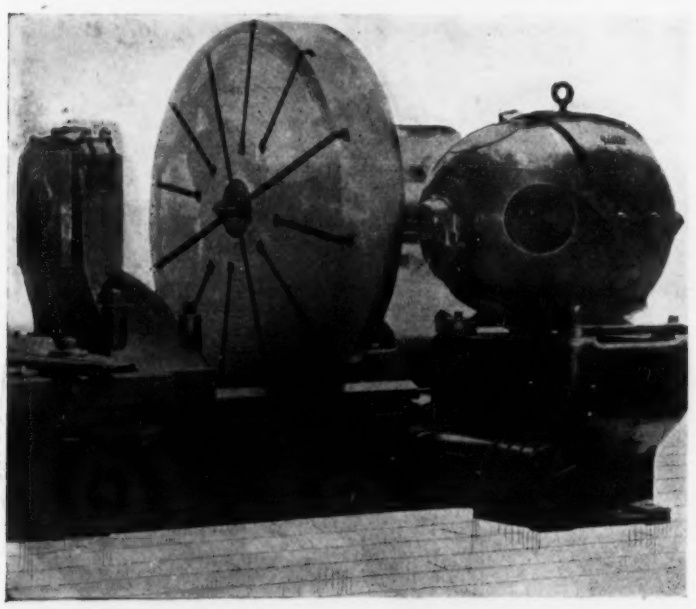


FIG. 2.—MOTOR END OF LATHE.

electrical changes are supplemented by mechanical changes obtained through the all-gear headstock, by means of the two levers shown on the front of the hood. This headstock contains an assemblage of gears oppositely disposed on the upper and lower shafts, engaged and disengaged by throwing the levers to right or left. The proper combination of the levers for any desired speed is indicated by prominently-placed index plates. The range of speeds thus obtained through both the headstock and the motor is very wide, varying by minute gradations, and far superior to the machine driven by belt through cone pulley. The levers operating the gears in the headstock are readily thrown as the operator desires by simply releasing a knob and all danger and liability to error are eliminated—a very important consideration in the operation of these heavy lathes. The compactness and neatness of the entire arrangement of the headstock and the motor drive are well shown up in Fig. 3.

Below the all-gear headstock, or the head end of the bed, is located the geared feed-changing device; through the three levers placed on the front of the box seven distinct and positive feeds are obtainable, without removing a single gear. The gears are mounted on two shafts and are completely housed in. Simple index plates show clearly the various combinations for obtaining any desired thread, pitch or feed. Aside from the motor drive, the features of especial interest on this particular lathe are the roll-turning attachments. The heavy housings shown are for the purpose of holding heavy pipe roll castings. At the rear of the machine, mounted on

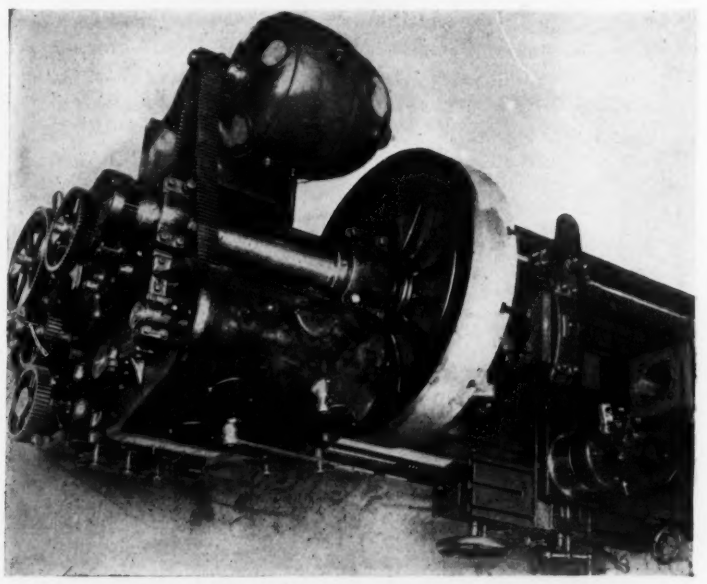


FIG. 3.—BIRD'S-EYE VIEW OF DRIVING GEAR.

the rear of the bed, is shown an interesting roll-forming attachment, well conveyed by Figs. 2 and 3, the purpose of which is to impart curved surfaces to long pipe-straightening rolls. It operates on the principle of a taper attachment: a shoe, provided with anti-friction rollers, slides in a trough following master bars, thus generating the same curve on the rolls being turned. Straight work can be turned by simply disengaging the nut which holds the shoe and by tightening the cross feed nut.

The concaving rest shown in Fig. 3 is interchangeable with the compound rest, and is used for grooving out pipe-welding rolls, with capacity for rolls for pipe from 2 to 20 in. diameter.

Drill Clamps for Car Tracks.

The illustration (Fig. 1) shows a type of drill clamp specially adapted for use where the running of trolley cars cannot be interrupted. As will be seen, all sections of the clamp are well removed from the upper surface of the rail, so that no adjustment need be altered on account of the movement of the cars. "Security" drill clamps are made to attach to the base of any rail and to remain firmly there while in use. The end hooks over one side of the flange and

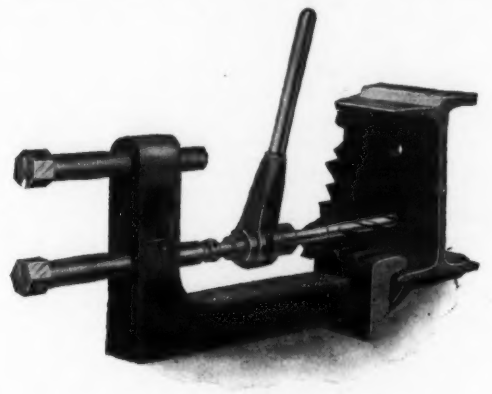


FIG. 1.—DRILL CLAMP IN POSITION.

the sliding claw fits over the other. There is no bend or spring to it, and when the drill is in use the alignment is preserved.

The vertical arm holds two adjusting screws, each 1 in. by 8 in., which follow the drill forward. They are of ample size to stand heavy use and are cupped to receive a ratchet head. Two screws are provided to save time for the workman, and their centers are respectively set 2 and 6 in. above the horizontal arm. In use this arm comes tight against the rail base, so these measurements apply to the rail itself.

The Security drill clamp is made by the F. Bissell Co., manufacturers and jobbers of electrical goods, 226-230 Huron Street, Toledo, Ohio.

A New Type of Insulation.

Owing to the indestructible qualities of asbestos, it has received much attention as a base for insulation, with the result that several of the largest companies manufacturing electrical goods have made use of it in the insulation of field coils for railway motors and other machinery where the rise in heat is likely to be destructive at times to ordinary insulations.

The latest addition to asbestos insulations is a product offered to the trade under the name "Green's Insulation." The inventor of this insulation, John F. Green, of Pittsburg, Pa., claims to have found a process of extracting the oxides of iron from mineral asbestos, leaving only asbestos and quartz in the final product. This, he says, increases many times the insulating qualities of papers and fibres in which have hitherto been incorporated the mineral.

The specific gravity of the treated material is less than that of the natural mineral, and though the fibre of the material appears shorter than before, paper made of it possesses practically the same strength as the long fibre paper. Laboratory tests have given the following results:

Thickness of sample.	Breakdown tests, volts.
1. 0.0045 inch	1800
2. 0.0230 inch	2800
3. 0.0540 inch	5400
4. 0.1000 inch	15000
5. 0.2500 inch	21000

These tests were made between plates having three square inches of surface area. Sample No. 1 was a single sheet of manila paper with asbestos on either side not treated in any way. The other four samples were of pressed asbestos board and rubber, both being formed under a pressure of 2,000 pounds to the square inch. In the laboratory tests above mentioned, the insulation resistance of No. 3 and No. 4 was so high that no deflection was obtained with a galvanometer having a constant of 34,000 megohms. Tests of the material after subjecting it to varying degrees of moisture (using distilled water), showed that it was a fair insulator when wet for low voltages, but broke down from electrolysis, setting up after standing 500 volts for 15 seconds, the paper of 0.0045 in. thickness being fully saturated. Paper treated with a thin, even coat of varnish turned the water and gave good tests to the best empire cloth.

As a test in actual service of the properties of the insulation under varying temperature conditions, two runs were made of a 5-hp shunt motor of the multipolar type, the machine being built by the Crescent Electric Company, Pittsburg, Pa. Two of the field coils and the armature were wound with wire insulated by winding Green's insulation in ¼-in. tape strips spirally, a single cover of cotton insulation being put over all.

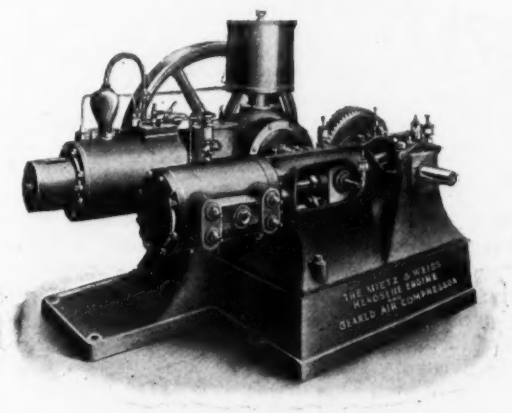
The machine was wound to run on 110 volts, being one of several machines that had, with ordinary insulation, given a test under a 50 per cent. overload, a rise of 48° in the armature. A direct comparison could, therefore, be made between the rises in temperature of the machine as newly wound and the former ones.

In the one-hour run with a 30 per cent. overload, the rise in the armature was 39°. The field coils with both insulations showed no difference in temperature, all rising uniformly only 20°. After the run ten coils were consecutively short-circuited at the commutator and the motor started without load. The coil in each instance would come to a red heat, the cotton insulation burned off and the resulting short-circuit burned out on the commutator bars without stopping the machine.

While this test was an unnecessary one, it proved the indestructibility of the insulation, which immediately after the tenth coil was burned out was subjected to a 500-volt ground test—four times the normal voltage—without showing weakness as a result of the run of the short-circuiting heat test.

Kerosene Engine for Constructive Work.

It has frequently been determined that as a source of energy man is the most expensive agent available. In all modern manufacturing establishments, with almost no exception, the hammer and cold chisel and similar muscle-driven tool combinations have been superseded by mechanically operated tools. What has been found of such advantage for shop work is to a continually increasing extent being adopted for other lines of semi-portable undertakings. In the erection of modern buildings an immense amount of small tool work is necessary, and contractors have not been slow to appreciate the economy and rapidity with which construction can be accomplished when a proper mechanical power equipment is installed. As an ex-



AIR COMPRESSOR DRIVEN BY KEROSENE ENGINE.

ample of such equipments may be cited the one adopted by the contractors, Ritchie, Brown & Donnelly, in the erection of the building at Forty-second Street and Park Avenue, New York, now in course of construction. For the operation of pneumatic tools there has been installed a 10-hp Mietz & Weiss kerosene engine directly geared to an air compressor, as shown in the engraving. The air compressor is in size 8 x 8, and gives 70 cu. ft. of free air per minute against 80 pounds pressure.

The August Mietz Iron Foundry & Machine Works, 128-138 Mott and 87-89 Elizabeth Streets, New York, are the manufacturers of the above-described equipment.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was an eventful one in the rising tendencies, and hopeful conditions were seriously though not permanently checked by the ugly strain of relations between England, Russia and Germany over the seizure of steamers in the Red Sea and the Eastern waters. The trouble seems to have been patched up by Russian admission of error and by the virtual backdown of the Czar; but the episode, even if closed, has done no good. Under the circumstances, securities both here and in Europe have declined, and it would be hard to see what else they could do; but all the same, the situation is a healthy one, and even the check to a rise has its beneficial side. Confidence is far stronger than it was, stocks are in strong hands, at every opportunity the market stiffens up, and the New York surplus bank reserve at a level above $55,000,000, and money at 1 per cent. indicate the unusual monetary ease. Even the political situation is good, for both candidates stand on a platform of sound money and financial integrity for the nation. For the week, Allis-Chalmers was decidedly up, General Electric was steady, Westinghouse Electric eased off on new emissions of securities, Western Union was apathetic, and tractions moved little except downward in sympathy with the depression due to war as noted above. Following are the closing quotations of August 2:

NEW YORK

	July 26	Aug. 2		July 26	Aug. 2
Allis-Chalmers Co.	11¾	11	Electric Vehicle	9	9
Allis-Chalmers Co. pfd.	52	48	Electric Vehicle pfd.	13⅛	13½
American Tel. & Cable	89	87	General Electric.	160½	162⅛
American Tel. & Tel	131½	134¾	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	115	118¾
Brooklyn Rapid Transit.	50¾	51⅜	N. Y. & N. J Tel.	147	147
Commercial Cable.	181	181	Marconi Tel.	..	..
Electric Boat.	41	40	Western Union Tel.	88	88⅛
Electric Boat pfd	70	70	Westinghouse com.	154	155
Electric Lead Reduction	⅛	1	Westinghouse pfd	175	170

BOSTON

	July 26	Aug. 2		July 26	Aug. 2
American Tel. & Tel.	131½	134¾	Western Tel. & Tel. pfd.	90	91½
Cumberland Telephone	114	116¾	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	248	249	New England Telephone	124	123
General Electric	160	162	Mass. Elec. Ry	17⅜	17½
Western Tel. & Tel.	12¼	13⅛	Mass. Elec Ry. pfd.	70	69⅜

PHILADELPHIA.

	July 26	Aug. 2		July 26	Aug. 2
American Railways	47	47	Phila. Traction	98¼	..
Elec. Storage Battery	60	60	Phila. Electric	6⅛	6⅛
Elec. Storage Battery pfd.	60	60	Phila. Rapid Trans.	13	12¾
Elec. Co. of America	8¾	8¾			

CHICAGO

	July 26	Aug. 2		July 26	Aug. 2
Central Union Tel.	..	..	National Carbon pfd.	103	104
Chicago Edison	143	..	Metropolitan Elev. com.	19⅝	20
Chicago City Ry.	170	170	Union Traction	4¼	..
Chicago Tel. Co.	120	120	Union Traction pfd.	28	..
National Carbon.	30	30¼			

WHITNEY AND METROPOLITAN.—The manner in which large ownerships may sometimes be quietly shifted in traction or other properties is interestingly discussed as follows by the New York *Evening Post:* "The late W. C. Whitney had for years, prior to his death last February, been conspicuous in all large financial operations of the Metropolitan Street Railway. When the inventory of his $21,000,000 estate was filed at the tax office on Wednesday, it showed no holdings whatever of Metropolitan stock. Yet he was certainly once a very heavy holder. A more or less close financial associate of Mr. Whitney made this comment on the inventory: 'The Metropolitan shares are believed to have been sold a year and a half ago, at about the time of the formation of the Metropolitan Securities Company. Mr. Whitney personally led the organization of that company. He probably thought it was a convenient means to enable him to sell some of his Metropolitan Street Railway stock.' But why did he have to sell an investment of which his frequently expressed opinion was so high? There were two possible good reasons. One is suggested by the experience of other financiers who indulged in 'undigested securities,' and by the evidence of such holdings in last Wednesday's schedules; the other, by the fact that the famous securities 'deal' of February, 1902, sent Metropolitan up from 160 to 174, whence it dropped promptly back to its old price, under heavy selling. The nearest parallel case, all things considered, was that of Roswell P. Flower. The 'Governor' had personally conducted the famous 'boom' of 1899, which converged on Brooklyn Rapid Transit and Rock Island. He was the head of a 'pool' supposed to hold enormous blocks of each, and he died, very suddenly, when the public, at his urgent advice, was still buying both. When his will was probated, it was found that he held less than 100 shares of Rock Island stock and barely 1,000 'B. R. T.' At ruling prices, these stocks were good enough for the outside public, but not for him."

NIAGARA POWER.—It is alleged that the Vanderbilt interests are behind the Niagara, Lockport & Ontario Power Company, which was incorporated recently to supply electric power from the Niagara River. This company will be operated in connection with the Central's plans for absorbing local traction companies which compete with the railroad in central and northern New York State and electrifying portions of the West Shore Railroad and the Rome, Watertown & Ogdensburg to make connections between the traction companies which it controls. At a recent meeting of the directors of the power company it was resolved to issue $24,000,000 of bonds to build and equip the new power plant. These securities will not be a direct obligation of the Central, but may bear its guarantee. It was roughly estimated recently that it would require $50,000,000 to carry the plan to its consummation. In addition to the cost of the Lockport plant and the electrification of portions of the Vanderbilt system, the primary cost of purchasing a controlling interest in the traction companies desired must be taken into consideration. The Central has already joined the Andrews syndicate in the control of the Utica and Syracuse systems, and has been negotiating jointly with the Delaware & Hudson for the Schenectady system, which has trackage rights over the Albany system. It has been reported that the Central would acquire all the companies along its line, aggregating nearly five hundred miles and a capitalization of approximately $100,000,000. Officials of the company, while admitting that the Central's plans are extensive, state that they involve no such acquisitions as these reports have represented, and that the development of the scheme for electrifying roads for the short haul business will be worked out slowly. It was denied that there is any intention of electrifying the entire West Shore road, as has been reported.

SALE OF TRENTON HEWITT PLANT.—The United States Steel Corporation has purchased the wire plant of the Trenton Iron Company, of Trenton, N. J., and has paid for it with second mortagage 5 per cent. bonds. The exact price paid has not been officially stated, but it is known that the directors of the Steel Corporation consider the terms distinctly advantageous and that the Steel Corporation will net not less than 25 per cent. on the purchase price. The Trenton Iron Company was organized by a special act of the Legislature in 1847, and its original incorporators were: Peter Cooper, James Hall, Edward Cooper and Abram S. Hewitt. Its last report of date, September 17, 1903, shows directors and officers as follows: Directors—Edward Cooper, Peter C. Hewitt, Edwin F. Bedell, Erskine Hewitt, Lloyd S. Brice. Officers—President, Edward Cooper; vice-president, Erskine Hewitt; treasurer, Charles E. Hewitt; secretary, Eagleton Hauson. The authorized capital stock of the company is $2,000,000, but the actual amount issued and outstanding is $600,000. The American Steel & Wire Company will operate the plant, which, in its time, has turned out a large amount of iron and steel wire for electrical use.

RICHMOND PASSENGER AND POWER.—Judge Mullen has filed his opinion in the case of George E. Fisher and others against the Virginia Passenger & Power Company et al. It grants Mr. Fisher's plea for the appointment of a receiver, taking the ground that the company is insolvent and that an accounting is necessary to protect the rights of all concerned. This is adverse to the Gould interests, at whose instance a few days ago Judge Waddell appointed receivers for the whole system of which the Power & Passenger Company is a part. The petitioners based their plea on the ground that it was necessary to prevent the wrecking of the system by the harassing suit of Fisher. Counsel for the Goulds in the Petersburg case will appeal to the State Supreme Court.

LIGHTING REPORTS.—Stone & Webster report as follows for the subjoined properties: Minneapolis General Electric Company—May gross earnings, $45,768.45, against $41,236.02. The net for the 12 months was $161,875.96, against $125,799.10. Lowell (Mass.) Electric Light Corporation—May gross, $18,232.75, against $17,164.75. Net profit for the 12 months, $74,749.14, against $61,201.46. Edison Illuminating Company, of Brockton—May gross, $7,957.20, against $7,079.50. Net profit for the 12 months, $33,864.62, against $17,977.37.

BROCKTON EDISON STOCK.—The Board of Gas and Electric Light Commissioners of Massachusetts has authorized the Edison Electric Illuminating Company, of Brockton, to issue 1,000 shares of additional capital stock at $100 per share. The proceeds of 500 shares will be used to pay off the floating debt incurred by additions to the plant and 500 shares will be devoted to the purchase of the Whitman Light & Power Company.

WESTCHESTER LIGHTING DEAL.—The terms in detail which the United Gas Improvement Company and other stockholders in the Westchester Lighting Company receive in the sale of the property are reported at follows: The N. Y. & Westchester Lighting Company acquires the preferred and common stocks of the Westchester Lighting Company, of which a large majority in each class of stock is owned by the United Gas Improvement Co., the minority shares being mostly held locally around Westchester. These stocks are to be exchanged par for par in bonds of the new company, the principal and interest of which is guaranteed by the Consolidated Gas Company of New York. Westchester Lighting preferred stock is exchanged for a 5 per cent. 50-year debenture bond and Westchester Lighting common stock is exchanged for a general mortgage 100-year bond interest, on a sliding scale beginning at ½ of 1 per cent. and rising to 4 per cent. in 1904 and thereafter. The U. G. I. Company, it is understood, will take no interest in the stock of the new Westchester Company, it being controlled entirely by the Consolidated Gas Company. There is $2,500,000 preferred and $10,000,000 common stock of the present Westchester Company outstanding. There is also a $10,000,000 first mortgage on the Westchester property under which about $6,000,000 bonds have been issued. It is said to be the estimate of the U. G. I. management that the general mortgage bonds of the new company which is to take over the Westchester Lighting Company, which bonds are to draw interest on a sliding scale, aggregating 4 per cent. in ten days, will at the end of that period be worth par, guaranteed as they are to be principal and interest by the Consolidated Gas Company. The U. G. I. Company, it is understood, is to accept these bonds in purchase of its $6,000,000 in the common stock of the Westchester Lighting Company.

DIVIDENDS.—The directors of the Cambridge (Mass.) Electric Light Company have increased the dividend on that company's stock from 6 per cent. to an 8 per cent. basis. A quarterly dividend of 2 per cent. is payable August 1. The company has been paying dividends at the rate of 6 per cent. per annum for the past ten years. The New England Telephone & Telegraph Company's directors have declared the regular quarterly dividend of 1½ per cent., payable August 15.

Commercial Intelligence.

THE WEEK IN TRADE was such as the middle of the summer season might be expected to record, but there was an element of hopefulness and improvement in it all that was very encouraging. One sign was that the manufacturers of iron and steel products are going steadily forward in their work of enlarging and improving their plants. The Jones & Laughlin Steel Company is arranging to build three more furnaces at its plant in Pittsburg. The Union Rail Company has plans under consideration for building an additional thirty-foot furnace at Huntington, W. Va., and is equipping its plant for the manufacture of rolling brake beams, special shapes and light section rails. The Midland Manufacturing Company, manufacturer of agricultural implements, at Tarkio, Mo., is erecting several new buildings and providing extensive new equipment. The Auto Car Company, of Ardmore, Pa., is arranging to erect new machine shops; the Colonial File Company is preparing to erect an extensive new factory at Dorchester, which will cover an area of about 24,000 square feet; the Simonds Manufacturing Company, of Fitchburg, Mass., has just broken ground for the erection of an extensive addition to its factory, and will also build a power plant in connection therewith. The Reeves Manufacturing Company, of New Haven, has just increased its capital from $50,000 to $250,000 for the purpose of making extensions and enlargements. The Racine Boat Company, of Muskegon, Mich., is preparing to build a new factory and an annex to its brass foundry. J. E. Palmer, of Middletown, Conn., is building a four-story addition to his hammock manufacturing plant. These are but symptomatic. There are good reports from various branches of trade, and dry goods jobbers say that they have been booking heavy fall orders. The domestic and export demand for cotton goods is excellent. There was practically no change in copper for the week, it being quoted at 12.62½ New York as a week ago.

CONSOLIDATION AT RIO DE JANEIRO.—The Rio de Janeiro Tramway, Light and Power Company has been incorporated in Canada with a capital of $50,000,000 to consolidate the street railway, electric light, heat and power companies of Rio de Janeiro. Mr. F. S. Pearson, of New York, is the head and front of this proposition and asociated with him are W. R. Bull, of New York; Sir William Van Horne, of Montreal; William MacKenzie, E. R. Wood and George A. Cox, of Toronto. It is proposed to raise $22,500,000 at first by the issue of $25,000,000 bonds at 90 with 100 per cent. bonus in stock to the underwriters. These payments will be spread out over a year. Mr. Pearson has obtained a concession from the Government of Brazil for obtaining water power from the falls of Sapucara, about 75 miles from Rio. This fall can yield 100,000 hp., of which 50,000 will be immediately developed and furnish current for Rio de Janeiro, a city of 800,000 inhabitants. Mr. James Mitchell, an American engineer, who has been at the head of the Sao Paulo Co., will be in charge of the work. It is probable that in time the entire $50,000,000 capital will be issued by the Rio Company. This would involve the acquisition of the tramway and the light, heat and power companies in the city of Rio de Janeiro.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended June 30, 1904, and since December 31, compares as follows:

	1904.	1903.	1902.	1901.
Gross output	83,312	87,608	96,653	96,300
Returned	44,144	42,189	41,741	34,221
Net output	39,168	45,419	54,912	62,079
Since December 31:				
Gross output	591,684	600,064	589,109	469,923
Returned	247,190	235,141	226,267	194,569
Net output	344,494	364,923	362,842	275,354
Total outstanding	4,124,001	3,515,243	2,888,854	2,228,170

The statement was not quite as favorable as expected, although an official of the company points out that this is "house-cleaning time" with the sub companies, and under the new system of rentals they are sending back all of the instruments for which they have no immediate use. On this account, the item of "returned instruments" is unusually large.

ANDRES LEFEBRE AFTER ANOTHER POWER CONCESSION.—Application has been made to the Mexican Government authorities by Mr. Andres Lefebre, president of the recently formed Compania Bancaria Catolica de Mexico (the Catholic Bank of Mexico City) and one of the leading capitalists of the southern republic, for the necessary concession for the construction of an extensive hydraulic plant on the Lagos River, at a point where it passes through the Hacienda del Salto, in the district of Lagos, State of Jalisco. The franchise sought embraces the use of 3,000 liters of water per second. The electrical current is to be used for lighting and power purposes in that locality.

TO BUILD PUEBLA POWER PLANT.—Mr. Miguel M. Navarro, of Mexico City, has obtained a concession from the Mexican government permitting the construction of a water power plant on the river Los Molinos, districts of Atlixco and Cholula, State of Puebla. The concessionaire obligates himself to begin work inside of six months. The usual franchises have been granted, including free importation of material, equipment, etc. The right to use 3,000 liters of water per second has been secured. Mr. Navarro has deposited $5,000 in bonds as a guarantee for the due performance of his part of the contract.

ELECTRIC DRILLS FOR SOUTH AFRICA.—The Mine & Smelter Supply Company, of Denver, Colo., New York offices Washington and Liberty Streets, has obtained an initial order from Mr. S. W. Bradbury, of Cape Town, Johannesburg and Port Elizabeth, who handles considerable quantities of Yankee equipment for the South African markets, for three Durkee electric drills, which are to be operated by General Electric motors and shipped to the Salisbury mining district.

POWER FOR MEXICAN SMELTING PLANT.—Mexican advices state that M. Francis Massillon, representing the smelting concern known as La Sociedad Altos Harrios Mexicanos, Canton de Jalapa, State of Vera Cruz, has applied to the Government for permission to develop electrical energy from the Arraya de las Fundiciones River for general power purposes.

WESTINGHOUSE LOCOMOTIVES FOR JAPANESE MINES.—Eight Westinghouse electric mining locomotives are to be shipped to Japan for use in the Besshe mines. These locomotives will be of 10 hp each. Two 180-kw Westinghouse generators will also be forwarded. These contracts were secured through the Japanese house of Takata & Co.

LIGHTING PLANT FOR TEPIC.—Alfred Lonergan, Cristobal Villanuena and Estiridon Ramirez, all of Ixtlan del Rio, Territory of Tepic, Mexico, have organized a company according to advices just received for the purpose of building an electric lighting plant in Tepic. The initial equipment will entail an expenditure of about $40,000.

CONTRACTS PENDING FOR MEXICAN HYDRAULIC PLANT.—Antonio A. Mott, of Mexico City, who has a concession which permits of the building of a fair-sized hydraulic plant on the Ozoloapam River, Cañon of Acayucan, is about to let contracts for its construction and equipment.

GERMAN ELECTRIC INDUSTRIES.—Mr. R. Guenther, United States Consul-General, Frankfort, Germany, states that the second part of the annual report of the Frankfort Chamber of Commerce for the year 1903 has just been published. It includes a statement made by the Lahmeyer Electric Company that "the increased activity of Germany's industries during 1903 has had a corresponding effect upon the company's business and that of the electric branch of Germany generally." This, however, did not bring about the longed-for advance in prices and profits, as competition continued exceedingly keen. Many orders were filled without profit, and many times goods were sold for less than the cost of production. The reason for this is to be found in the efforts of the great electric companies to give as much employment as possible to their plants, which had been considerably extended and enlarged. Another cause was "the competition arising from the growth of native electric industries in many foreign countries, which heretofore had been profitable markets for German electric goods. The strong efforts made by these domestic electrotechnical works to crowd out German supplies compelled German exporting concerns to offer exceedingly low terms in order to maintain their footing in these foreign countries. The high price of raw materials was also an obstacle under the above-noted business conditions. The prices of some of the raw materials advanced toward the close of the year; among these were copper, brass and dynamo wire. Owing to the establishment of a trust the price of incandescent lamps has been raised 50 per cent."

4,000-KW LIGHTING PLANT FOR WANAMAKER.—The largest and one of the most elaborate isolated lighting plants of its description in this country is to be installed in the huge new John Wanamaker department store now under construction in Philadelphia. The capacity of the plant will be 4,000 kw. Contracts for the equipment will be awarded next week through Mr. John W. Haddock, of Philadelphia, who is John Wanamaker's superintendent of construction. Big units will be put in. The electrical plant for the new store in New York, which was contracted for last April, is also to be a large one. The capacity will be 1,800 kw. The generators, six in number, will be of Westinghouse build and are to be direct-connected to Buckeye engines. The two biggest isolated lighting plants so far installed in this section are in the Macy department store and in the Metropolitan Life Building. Their capacities are around 2,000-kw each.

ORIENTAL CONSOLIDATED MINING COMPANY.—Horace N. Allen, the United States Minister at Seoul, Korea, has sent a communication to the State Department on the subject of the Oriental Consolidated Mining Company, an American gold mining company, operating a district in Northwestern Korea of 500 square miles under a concession from the Korean Government. The officers of the company are: H. C. Perkins, president; Leigh Hunt, first vice-president; Wm. L. Bull, second vice-president, and J. B. Huggin, Ogden Mills and J. S. Fassett, directors. Mr. Allen says that the company is the largest concern in Korea and that the work it is now doing is said to be the largest development work of its kind in Asia. Waterfalls have been utilized for power, the big mills, stamps and cyanide plants are operated by electricity and the most modern and progressive American methods are being utilized in the work of development.

PUMPS FOR MEXICAN MINES.—Pedro Alvarado, the Mexican silver king, has placed an important contract with the Worthington branch of the International Steam Pump Company, of 114 Liberty Street, New York, for a complete electrical pumping equipment for installation in his Tarral mines. The plant will comprise high-lift turbine station and sinking pumps having an aggregate capacity of 600 gallons per minute. There will be two stations and two sinking outfits operating on a 750-ft. head. They will be driven by Westinghouse special type waterproof motors of 130-hp capacity each. The contract was closed through Van Voorhis & Sanford, of Monterey, who represent the International Company in that section. The International Company has also a number of orders in hand for small turbine pumps to be used in other mines in the southern republic.

LARGE ELECTRIC TURBINE PUMPS FOR DRIVING ELEVATORS.—The International Steam Pump Company, of 114 Liberty Street, New York, Worthington division, has just secured the first large contract for turbine pumps to be used for operating elevators, such work having hitherto been undertaken by means of reciprocating pumps. The contract calls for two 6-in., 3-stage, high-lift, improved type centrifugal outfits to be operated by electric motors. This equipment will be installed in the One Hundred and Sixteenth Street station of the Manhattan "L." A contract has also been taken by the International Company for high-lift turbine pumps, electrically driven, for the new Vanderbilt houses, 645 and 647 Fifth Avenue. These outfits will be utilized for the purpose of pumping the household water supply.

LIGHTING IN GERMANY.—The Sachsenwerk, Licht-und-Kraft-Aktiengesellschaft, Niedersedlitz, Dresden, Germany, advises us that it has received among other important orders the following contracts: Electric plant for the city of Döbeln, Saxony, Germany; extension of the municipal electric plants of the city of Göttingen; power transmission plant for two 800-hp. and full electric equipment for Verein für Zellstoff-Industrie, A. G. Oberleschen; 375-h-p. electric motor, etc., for Kaliwerk Sollstedt; extensive electric equipment for one of the largest spinning mills of E. J. Clauss Nachf in Plaue-Flöha, and for the shipyards of H. C. Stuelcken Sohn, Hamburg, besides numerous orders for the Imperial Navy Department and other Government contracts.

LIGHTING PLANT FOR SCHWAB'S RESIDENCE.—Mr. Charles M. Schwab's new residence at Seventy-third Street and Riverside Drive, New York, is to have one of the most elaborate private lighting plants in the country. The equipment will have a capacity of 250 kw. There will be three units, two of 100-kw and one of 50-kw each. Mr. P. W. Finn, of Pittsburg, is the general contractor. Mr. J. T. Finn, Columbus Avenue and Sixty-seventh Street, New York, is the electrical contractor. Clark & MacMullen, Commercial Cable Building, Broad Street, are the consulting electrical engineers. Contracts for the equipment, etc., will, it is expected, be all determined on within the next ten days.

4,000-HP EQUIPMENT FOR WAIPORI, N. Z.—The Waipori (New Zealand) Electric Company, which concern is to develop electric current at its hydraulic plant, some 20 miles distant from Dunedin, for the purpose of eventually lighting that city and operating the electric traction system, has placed contracts in this country for about 4,000 hp of equipment. The Pelton Water Wheel Company, of 143 Liberty Street, secured a contract for two wheels of almost 2,000-hp capacity each. These wheels will be direct-connected to dynamos of 1,000-kw capacity each to be built by the General Electric Company.

ANOTHER GUANAJUATO WATER POWER PROJECT.—Mexican advices state that Mr. Enrique Silva, of Penjamo, State of Guanajuato, has applied to the authorities for the purpose of securing a concession to utilize 4,000 liters of water per second from the River Angulo or Zacupu, State of Michoacan, District of Puruandiro. The power will be used chiefly for lighting use in that locality. The equipment for the plant, which will be of United States manufacture, is expected to be contracted for within the next 30 days.

4,300-HP EQUIPMENT FOR PUEBLA.—The Portezuelo Light & Power Company, of Puebla, Mexico, has awarded contracts for equipment to be installed in a 4,300-hp plant. There will be one Pelton wheel of 1,700-hp capacity and two of 1,300-hp capacity each. The Pelton Water Wheel Company has also secured a contract for the pipe line, consisting of 3,000 feet of 40-in. pipe. The General Electric people secured a contract for a 1,200-kw generator, the other machines being already on the spot.

TELEPHONE SYSTEM FOR RUSSIA.—The Western Electric Company, of this city and Chicago, has obtained a contract for the installation of a telephone exchange system at St. Petersburg, Russia, capable of taking care of 40,000 subscribers. The wires will be laid in American conduits, some of the material having lately been shipped from the plant of the National Fire Proofing Company, at Raritan, N. J.

500-MILE MEXICAN TELEGRAPH SYSTEM.—The Mexican Light & Power Company, Limited, of which concern F. S. Pearson, 29 Broadway, is the consulting engineer, has awarded a contract to the John A. Roebling Sons Co. for about 500 miles of No. 12 wire, to be used in the construction of the telephone system between the Necaxa power station and Mexico City and El Oro.

APPARATUS FOR CUBA.—Mr. E. G. Bernard, of Troy, N. Y., has lately been very busy over export orders, chiefly for Cuba. He has recently sold the lord chief justice of Spain a light and power plant for his plantation there, the "Confluenta," and has also executed some good orders for Brooks & Company, an English firm, operating eight plantations in the island.

PLANT FOR TEPIC MINES.—Dr. Carlos Fenelon and Dr. B. W. Wallace and other American associates who recently purchased the Barranca del Oro mining property, situated south of Ixtlan Territory of Tepic, Mexico, are about to install an electric power plant. They will also build electric tramways to connect the mines with the mill.

PROJECTED CUBAN LIGHTING PLANT.—A project is under consideration for an electric lighting system in Guines, a Cuban town of some 4,000 inhabitants, about 50 miles from Havana. Mr. F. J. Pattin, secretary and treasurer of the Guines Vegetable Growers and Shippers' Association, is interested in the scheme.

J. G. WHITE & CO. TO LIGHT BOMBAY.—J. G. White & Co., Limited, of London, England, has been awarded an interesting contract for the construction and equipment of an electric lighting system in Bombay, India. The value of the present contract is in the neighborhood of $200,000.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit. Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore. Next meeting, New Castle, N. H., Aug. 30 and 31 and Sept. 1, 1904.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Chattanooga, Tenn., third Wednesday in May, 1905.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Colorado Springs, Sept. 21, 22 and 23, 1904.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa. Next meeting, New York City, December, 1904.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

INTERNATIONAL ELECTRICAL CONGRESS. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday in March, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept. 12-16, 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Canton, Nov. 18, 1904.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, F. E. Scovill, Austin, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

COLUMBIANA, ALA.—The White & Davis Telephone Company has been incorporated with a capital stock of $10,000, by W. P. White, W. F. Davis and others.

SAN BERNARDINO, CAL.—The Arizona, Nevada & California Telephone Company proposes to build a system through Nevada, Arizona and Southern California and to mining camps on the desert.

TUSCOLA, ILL.—The Tuscola Telephone Company has increased its capital stock from $5000 to $10,000.

DAHLGREN, ILL.—The Dahlgren Telephone Company has increased its capital stock from $5000 to $10,000.

CHAMPAIGN, ILL.—The Home Telephone Company has increased its capital stock from $25,000 to $100,000.

SHELBYVILLE, ILL.—The Duvall Mutual Telephone Company has been incorporated with a capital stock of $420, by J. L. Hawk, C. E. Krieg and M. D. Piez.

SCIRCLEVILLE, IND.—The Scircleville Telephone Company has been incorporated with a capital stock of $6000. The incorporators are A. M. Scircle, Charles K. Lewis, Emanuel Trask.

IDAVILLE, IND.—The Idaville Co-operative Telephone Company has been incorporated with a capital stock of $9000. The incorporators are T. B. Grim, J. F. Royer and T. J. Melon.

INDIANAPOLIS, IND.—The Majenica Telephone Company, Majenica, Ind., has been incorporated with a capital stock of $2000. The incorporators are Sherman Sprowl, George W. Gill, J. F. Hoover, Daniel Shideler and C. W. Myer.

PORTLAND, IND.—Articles have been filed with the Secretary of State for the Farmers' Co-operative Telephone Company with a capital stock of $15,000. The incorporators are W. W. Harkins, Stephen Straley, E. W. Polley, George W. Hall, W. I. Journay, S. W. Haynes, W. S. Rhodes, W. W. Timmonds and J. H. Sell. The company proposes to establish an exchange in this town and operate a system of country lines.

SCRANTON, IA.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $10,000. The directors are N. E. Christian, John Page and others.

STOCKPORT, IA.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $10,000. The directors are R. M. Harlan, D. Morris and others.

PATON, IA.—The Paton Mutual Telephone Company, which was recently incorporated with a capital stock of $10,000, has elected officers as follows: President, J. S. Williams; vice-president, W. H. Fallinon; secretary, K. C. Latta; treasurer, W. H. Fowler; manager, H. H. Waldron.

ELLSMORE, KAN.—The Katy Telephone Company has been incorporated with a capital stock of $2800.

OLDHAM, KY.—The Oldham Telephone Company has increased its capital stock from $10,000 to $20,000.

GALENA, KAN.—The Galena Home Telephone Company has been incorporated with a capital stock of $10,000.

GOODLAND, KAN.—The Sherman County Telephone Company has been incorporated with a capital stock of $5000.

COUNCIL GROVE, KAN.—The Council Grove Telephone Company has been incorporated with a capital stock of $30,000.

SOUTH DOVER, MICH.—The South Dover Telephone Company has increased its capital stock from $1000 to $2000.

ST. JOSEPH, MICH.—Articles of incorporation of the Funston Long Distance Telephone Company have been filed in the office of the county recorder. The company has a capital stock of $15,000. The directors are Edmund B. Funston, Jesse G. Funston, J. J. Funston and Thomas J. Porter.

THREE RIVERS, MICH.—At the annual meeting of the Three Rivers Telephone Company the reports of the secretary and manager were so satisfactory to the stockholders that the old officers were unanimously re-elected. A 6 per cent. dividend was declared and the company starts out with everything looking prosperous for the coming year.

GRAND RAPIDS, MICH.—Through negotiations closed by Henry M. Wallace, of Grand Rapids, with Chicago capitalists, a railroad or interurban line operated out of Chicago is to be equipped with the car telephone system, the patents for which are owned by the American Car Telephone Company. About ten miles of road are to be equipped. D. A. McCloud, of Grand Rapids, has arranged with the St. Louis, St. Charles & Western interurban for the equipment of its 15 miles of railway with this car telephone system.

ST. LOUIS, MO.—The Suburban Telephone Company has been formed and incorporated by citizens of St. Louis County, with a view to providing cheaper suburban telephone service. Articles of association have been filed at Clayton, and H. W. Karrenbrock, of Clayton, will act as agent. Other stockholders are J. P. Phelan, of Wellston, J. D. Houseman, of Ferguson, C. R. Black, of Clayton, and W. L. Travers, of St. Louis. The capital stock is $100,000.

ELGIN, NEB.—The Antelope County Mutual Telephone Company has been incorporated with a capital stock of $60,000.

CONCORD, N. H.—The Weare Telephone Company has been incorporated with a capital stock of $3000.

ROSWELL, N. M.—The Artesia Telephone Company has been incorporated. The capital stock is $25,000, and the directors are Harry W. Hamilton, Samuel P. Donning and James Cottingham, of Roswell.

PENN YAN, N. Y.—The Himrod Telephone Company has been incorporated with a capital stock of $2000. The directors are E. P. Porter, H. S. Voorhees and others.

NEW YORK, N. Y.—The Burdette Home Telephone Company has been incorporated with a capital stock of $5000. The directors are H. R. and M. L. Martin and S. B. Allen.

ALBANY, N. Y.—The Burdett Home Telephone Company, of Burdett, Schuyler County, has been incorporated with a capital stock of $5000. The directors are H. R. Martin, H. M. Clark and C. W. Daniels, of Burdett.

CANANDAIGUA, N. Y.—At the annual meeting of the directors of the Seneca-Gorman Telephone Company held at Stanley, the annual report showed the concern to be in a prosperous condition. A 6 per cent. dividend was declared and plans were discussed for the extension of the lines. The capital stock was increased from $10,000 to $30,000. The company now has sixty miles of toll lines. The election of officers resulted as follows: President, John A. Driscoll, of Rochester; vice-president, Dr. D. S. Allen, of Hall's; secretary and treasurer, Rice Macauley, of Stanley.

GENEVA, N. Y.—The Empire State Telephone Company, the local branch of the Bell Telephone Company, has planned to lay out $30,000 to $35,000 for improvements to its lines and equipments. Of this sum some $12,000 will be expended on a multiple switchboard, which will be installed in the new quarters recently leased in the Dove Block. The balance of the appropriation for betterment will be expended in new lines and in the replacement of the open wires with cables in the congested part of the city.

STATESVILLE, N. C.—The Board of Aldermen of Statesville has refused to grant a franchise to the Bell Telephone Company to operate in this city.

OMEMEE, N. DAK., is to have a telephone system.

MILTON, N. DAK.—The Milton Telephone Company intends to build a line to Soper.

NORTHWOOD, N. DAK.—A farmers' line is to be constructed north from Hatton to Portland.

ADAMVILLE, OHIO.—The Adamville Telephone Company has increased its capital from $10,000 to $30,000.

EAST LIVERPOOL, OHIO.—The Bell Telephone Company will erect a $25,000 building here for its offices.

PHILLIPSBURG, OHIO.—The Acme Telephone Company has increased its capital stock from $8000 to $15,000.

YOUNGSTOWN, OHIO.—The Youngstown Telephone Company has increased its capital stock from $200,000 to $400,000.

BROWNSVILLE, OHIO.—The Brownsville Co-operative Telephone Company has increased its capital stock from $2000 to $5000.

WESTMINSTER, OHIO.—The United Farmers' Telephone Company has increased its capital stock from $10,000 to $20,000.

CLEVELAND, OHIO.—The Federal Telephone Company has arranged to borrow $450,000 for the purpose of extending its lines.

TIPPECANOE CITY, OHIO.—The Tipp Interurban Telephone Company certifies to increase of capital stock from $10,000 to $30,000.

COLUMBUS, OHIO.—The Mt. Pleasant Telephone Company, of Jefferson County, has increased its capital stock from $500 to $10,000. Michael Gallagher is the president.

ORRVILLE, OHIO.—The Gemmill Telephone & Manufacturing Company has been incorporated with a capital stock of $60,000. The directors are W. S. Timms, T. S. Dunlap and others.

CHATHAM, OHIO.—The Chatham Mutual Telephone Company, of Medina County, has been incorporated by A. B. Hurst, John Yoder, Jr., W. H. Ripley, D. A. Clapp and A. R. Clapp.

DEXTER CITY, OHIO.—The Dexter City Southwestern Telephone Company has been incorporated with a capital stock of $10,000. The directors are A. Schriver, J. D. Headley and others.

PIQUA, OHIO.—The Miami Valley Telephone Association has been formed here by 23 independent telephone companies in Miami, Clark, Shelby, Logan, Champaign, Darke and other counties.

COLUMBUS, OHIO.—The Girard Telephone Company has been incorporated with a capital stock of $35,000 by E. H. Sotze, J. C. Koehl, E. L. Hauser, S. C. Hazen, J. G. Jones, W. J. Wallis and R. T. Izant.

COLUMBUS, OHIO.—The Wren Telephone Company, of Van Wert County, has been incorporated with a capital stock of $10,000. The incorporators are J. L. Moses, L. M. Hassman, F. W. Lichtensliger, O. J. Herman, B. O. Jones, E. L. Sheets.

TYRON, OKLA.—The Lincoln County Rural Telephone Company has been incorporated with a capital stock of $5000, by T. D. Rush and others.

DALAMATIA, PA.—The Citizens' Telephone & Telegraph Company has been organized with E. R. Reitz as president.

CHEAPSIDE, TEX.—The Cuero & Cheapside Telephone Company has been incorporated with a capital stock of $5000. The directors are C. F. Carson, J. F. Elder and others.

ALEXANDRIA, VA.—The Central Mutual Telephone Company has been incorporated with a capital stock of $5000. William M. Wheeler is president.

UNION GROVE, WIS.—The Union Grove & Paris Telephone Company has been incorporated with a capital stock of $2000, by D. P. Gorham, H. Barnes and others.

MONTREAL, CANADA.—The Bell Company has 10,000 subscribers now in Montreal, which is, in all probability, a larger proportion per head of population than almost any other city on the continent. In comparison with American centers of the size of Montreal the rates are lower, and this, to a large extent, accounts for the greater proportion of telephones in use. The company is now introducing the automatic call system.

ELECTRIC LIGHT AND POWER.

DECATUR, ALA.—It is stated that the city proposes to establish an electric plant.

SAN FRANCISCO, CAL.—The Board of Supervisors of San Francisco has decided to issue directions to the San Francisco Gas & Electric Company to install 40 more arc lamps in the southern part of the city. This means that the modernizing of San Francisco's street arc lighting system, at a cost of $50,000, will be carried on as rapidly as the Westinghouse Electric & Manufacturing Company can supply the new lamps, of which some 1500 have been ordered. Inclosed arc lamps will be hung on brackets about four feet from the pole.

SALINAS, CAL.—Articles of incorporation for the Vantana Power Company, with a capital stock of $500,000, have been filed. C. P. Bradford, of San Francisco; W. E. Bradford, of San Jose; F. L. Ordway and C. V. Hove, of Monterey; F. C. Richardson and C. M. Howard, of Pacific Grove, and H. S. Bradford, of Evergreen, are the directors. The company proposes to build a large dam at the junction of Vanta Creek and the Big Sun River, 46 miles south of Monterey, and to generate electricity from the water power to be carried to Monterey. It is stated that from 3000 to 5000 horse-power can be developed.

WASHINGTON, D. C.—Bids will be received Aug. 16 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing of the navy yards at League Island, Pa., Washington, D. C., and Naval Hospital, Philadelphia, Pa., a quantity of incandescent lamps, wire, cable, conduit and fittings, fuses and fuse wire, Warner electric gauge, miscellaneous electrical supplies, etc. H. T. B. Harris, Paymaster-General, U. S. N.

MILTON, FLA.—The Town Council has granted the Milton Electric Light Company a franchise.

KISSIMMEE, FLA.—The city is reported to have voted to issue $25,000 municipal electric light and power plant bonds.

TAMPA, FLA.—The Tampa Electric Company is preparing to construct an electric power house. It will be located on Hillsboro River. The new boilers and machinery will have a capacity of 1000 horse-power.

WRIGHTSVILLE, GA.—The Wrightsville Electric Light Company has been organized here with A. T. Cobb as president.

GRIFFIN, GA.—The citizens have voted to issue $100,000 bonds, $35,000 of which will be expended in improving and extending the electric light plant and water works.

THOMASVILLE, GA.—The Mayor and Council have entered a protest, with other citizens, against a bill introduced in the State Senate, providing for ownership of lighting plants by municipalities and making compulsory the purchase of existing plants.

GRIFFIN, GA.—The stockholders of the Flint River Power Company have organized with W. J. Kincaid, president, and J. P. Nichols, secretary. The company has a cash capital of $25,000, with the privilege of increasing it to $500,000, and will in the near future construct an electric power plant at Flat Shoals.

ROCKFORD, ILL.—The stockholders of the Central Heat & Power Company have decided to expend about $30,000 for additional electrical machinery to be added to the plant before fall.

LOGANSPORT, IND.—Thirty thousand dollars are to be spent in improving the lighting plant here.

SHELBYVILLE, IND.—It is reported that the Shelbyville Water & Light Company, of Shelbyville, has passed into the hands of a receiver, Frank Nucholls, superintendent of the company, being appointed. The improvements at the plant will continue, and the plant will be greatly extended.

DEFIANCE, IA.—The Defiance Telephone & Electric Light Company has been incorporated, with a capital of $15,000.

CONCORDIA, KAN.—The Home Light & Power Company has been incorporated with a capital stock of $50,000.

DANVILLE, KY.—Bids will be received by J. B. Fisher, Mayor, on Aug. 10 for an electric light and power franchise.

DANVILLE, KY.—Bids will be received until Aug. 10 by F. F. Lee, Clerk of the Board of Council, for the purchase of a 20-year franchise and to construct, maintain and operate an electric lighting and power plant in the city. The purchaser of the said franchise shall also have the right to construct, operate and maintain an electric street railway throughout the city.

BRUNSWICK, ME.—On account of low water in the Androscoggin River, it was necessary a few days ago to shut down the plant of the Brunswick Electric Light & Power Company for a few hours. Other plants depending upon the water power were also obliged to suspend operations temporarily.

PITTSFIELD, MASS.—E. P. Stearns, of Boston, Mass., is preparing plans for a power plant to be situated on the Housatonic River at Pittsfield. A stock company is being formed with a capital of $500,000.

GREENFIELD, MASS.—The Greenfield Electric Light Company has petitioned the Board of Gas and Electric Light Commissioners for an increase of $35,000 capital stock necessary to complete the construction of the large concrete dam and power station on the Deerfield River, the entire cost of which will probably amount to about $125,000.

SPRING VALLEY, MINN.—This city has adopted plans and specifications for a municipal electric lighting plant to cost about $10,000.

WOODVILLE, MISS.—The citizens have voted to issue $75,000 in bonds for an electric light plant and water works.

AURORA, MO.—The Aurora Light, Ice & Storage Company is arranging to introduce series alternating street arc lighting.

COLUMBIA, MO.—The city has purchased the water works and electric light plant and will take charge of the same on Aug. 1; thirty thousand dollars has been voted for improvements. John S. Bickness is City Clerk.

MISSOULA, MONT.—The Missoula Light & Water Company will, in 1905, construct a new steam plant, including boilers, engines and generators of about 500 kilowatts capacity. The probable cost will be $25,000.

LINCOLN, NEB.—Geo. H. Morse, of Lincoln, has secured the contract for the municipal electric light plant for $65,000.

CAMDEN, N. Y.—A new municipal electric lighting plant is being talked of here.

DESPATCH, N. Y.—The Despatch Heat, Light & Power Company, of Despatch, has been incorporated with a capital of $500,000. Directors: A. H. Bown and W. W. Bown, Penfield, and W. P. Thistlewaite, Macedon.

PORTCHESTER, N. Y.—The New York & Westchester Lighting Company, of Portchester, has been incorporated with a capital of $250,000, to operate in New York City, Yonkers, New Rochelle, Mt. Vernon and the towns and villages of Westchester County. Directors: Cortland Betts, of Morristown, N. J.; Fred. N. Gilboyl, of Brooklyn, and Jos. E. Freeman, of New York City.

RAEFORD, N. C.—A charter has been granted to the Raeford Power & Mfg. Company, with a capital of $200,000. The stockholders are J. W. McLaughlin, T. B. Upchurch and W. J. Upchurch, all of Raeford, and John Blue, of Aberdeen. The company will develop water and electric power, build and operate factories, etc.

LAMOURE, N. D.—There is talk here of constructing a municipal electric light plant.

HARRISON, OHIO.—J. P. Hornady & Company, Cincinnati, have purchased for Cincinnati and Cleveland, Ohio, capitalists the water works and electric light plant at Harrison.

SEBRING, OHIO.—It is proposed to increase the capacity of the plant of the City Light & Power Company.

NEW LONDON, OHIO.—The municipal electric light plant of this place is much overloaded and will have to be enlarged.

HILLSBORO, OHIO.—The Hillsboro Light & Fuel Company has increased its capital stock from $40,000 to $52,000. Mr. I. McD. Smith is president.

BOLIVAR, PA.—The Electric Light, Heat & Power Company is building a new plant.

NEWBERRY, S. C.—The City Council has decided to sell the present electric light plant and install a new system.

BATESBURG, S. C.—The Electric Light & Water Works Commissioners have contracted with Fred Minshall, of Abbeville, for the construction of the water and light plants for the town of Batesburg for about $18,500.

SPRINGFIELD, TENN.—Bids will be received by E. O. Hicks, City Clerk, on Aug. 10 for constructing water works and an electric light plant.

NASHVILLE, TENN.—C. H. Ackerman, of Binghamton, N. Y., is interested in the construction of an electric power plant at Caney Fork Falls. The syndicate of which he is a member is reported to have decided to take over the franchise and property of the present Great Falls Power Company.

HUNTSVILLE, UTAH.—The question of issuing bonds for an electric light plant is reported under consideration here.

AMERICAN FORK, UTAH.—The Utah County Light & Power Company, of American Fork, is considering a proposition to light Salt Lake City with power from American Fork Canyon. For this purpose it is intended to erect a plant of about 1000-hp capacity 1½ miles above the present plant.

HARRISONBURG, VA.—Bids will be received until Aug. 8 for $60,000 electric light bonds.

ALEXANDRIA, VA.—The City Council has granted Chas. F. Thompson a franchise for an electric light and power plant.

RICHMOND, VA.—An ordinance is about to be introduced in Common Council providing for a bond issue of $300,000, the money to be used in the construction of an electric light and power plant, on the site of the old pump house.

BURLINGTON, VT.—Bids will be received Aug. 22 at the office of the City Clerk for furnishing labor, material and equipment necessary for installing a complete electric plant of 250-kw capacity. Edward E. Morgan is chairman of the committee.

NEW CUMBERLAND, W. VA.—The City Council has considered favorably the plans of Engineer W. J. Miller, of Wheeling, for water works and an electric light plant.

RICHLAND CENTER, WIS.—The Richland Center Light Company was turned over to the city on July 1.

CLINTONVILLE, WIS.—The Clintonville Electric Light Plant is to be extended and new apparatus installed.

GREEN BAY, WIS.—The McCartney Electric Light & Power Company, of this place, has been sold to the Fox River Electric Light & Power Company.

BELOIT, WIS.—This city has given up the idea of having a municipal lighting plant and has just entered into a contract with the Beloit Electric Company to light the city for a period of ten years.

PORT ARTHUR, ONT.—The corporation of Port Arthur contemplates the installation of one 250-kw alternator, and a 500-hp water wheel.

OTTAWA, ONT.—An appropriation of $100,000 has passed the Parliament of Canada to provide for the electric lighting and power plant on the Welland Canal.

KINGSTON, ONT.—The city of Kingston, having paid $182,000 for the electric lighting plants, which become the city's property on August 1, is now likely to invest $100,000 more to thoroughly modernize the plants and to equip them for all increases that may be expected during the next ten years.

PRESTON, ONT.—The ratepayers of the town of Preston have decided in favor of municipal ownership of electric lighting plants. A by-law has been carried to raise the sum of $27,000 to purchase the existing incandescent plant and the arc system now owned by private individuals. A new power house will be erected and a first-class plant will be installed.

THE ELECTRIC RAILWAY.

ROCKVILLE, CONN.—The officers of the Rockville, Broad Brook & East Windsor Street Railway Company have completed the plans of the road. As soon as the remaining technicalities have been attended to the company will invite proposals.

WILMINGTON, DEL.—The Delaware Suburban Railway Company will soon start the construction of a road between this city and Elkton, Md. The right of way has been secured for the entire line, and it will be nearly 20 miles long. The power plant will be located at Newark, with a sub-station at Marshallton. The Delaware Suburban Railway Company has a capital stock of $500,000, and has issued bonds for $500,000. Benjamin F. Myers, of Harrisburg, Pa., is president; George E. Schlegemeilch, of Philadelphia, vice-president; Bernard Hoopes, of Philadelphia, treasurer, and R. H. Fothergill, of this city, secretary and chief engineer.

BRUNSWICK, GA.—Steps toward the construction of an electric railway from Baxley, in Appling County, to Reidsville, in Tattnall County, will be taken in the near future. Dr. Comas, of Baxley, and C. W. Dean, of Wayne County, are interested in the new road.

PETERSBURG, ILL.—The Springfield, Petersburg & Beardstown Interurban Railway Company reports that its proposed line will be 60 miles long. Franchise and rights of way are being secured and by next spring the line will be ready for financing and construction. R. E. Bone, Petersburg, is secretary of the company.

PONTIAC, ILL.—The directors of the Bloomington, Pontiac & Joliet Electric Railway have decided to increase the capital from $100,000 to $300,000, and to proceed at once with the construction of the line. W. F. VanBuskirk will have personal supervision of the work of construction, and will be assisted by John S. Murphy and C. E. Legg. The Arnold Electric Power Station Company, of Chicago, has been engaged as chief engineer.

PRINCETON, IND.—The name of the Evansville & Princeton Traction Company has been changed to the Evansville, Princeton & Indianapolis Traction Company. The company has effected a reorganization with the same officers. The company will build a branch line from Fort Branch to Owensville and New Harmony, and a branch line from Patoka to Union and Petersburg, in Pike County. Later the line will be extended on to Hazleton and Vincennes and connect into Indianapolis.

DES MOINES, IA.—J. S. Polk, president of the Des Moines City Railway Company and director of the Des Moines Interurban line, says that the Interurban Railway Company has about completed plans for the commencement of construction work on two lines of road out of Des Moines this season, giving the company, with the Colfax line, three roads.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company, which built the interurban line between New Albany and Jeffersonville, Ind., is closing arrangements for the construction of the line through Southern Indiana. The company expects to have a line from Jeffersonville to Sellersburg and eventually to Seymour, where the line will be met by a line from Indianapolis. From New Albany the company will build lines west to Corydon, north to French Lick and West Baden, and another from Vincennes to Princeton, where it will connect with the line of the Princeton & Evansville Traction Company, which is already in operation. With the completion of the lines contemplated, Louisville will be in direct communication by electric lines with Evansville and Indianapolis.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has increased its capital stock from $50,000 to $100,000.

BOSTON, MASS.—The receivers of the Lowell & Boston Street Railway, operating between Woburn and Billerica, have resumed operation of the property.

WORCESTER, MASS.—The Worcester & Northern Street Railway Company has completed its plans and surveys and secured all rights of way for an extension of its line to Winchester, a distance of 18 miles. The construction work will begin soon, and it is expected that the line will be opened by April 1 of next year. The generating plant will be equipped with two 800-kw alternating-current generators, 25-cycle machines, supplying current at 13,200 volts. There will be two sub-stations equipped with 300-kw rotary converters, transformers, switchboards, etc.

ADRIAN, MICH.—The Adrian & Ann Arbor Electric Railway Company has been incorporated with a capital stock of $300,000. C. R. Miller is president.

IRONWOOD, MICH.—The Ironwood-Bessemer Interurban Railway Company has been incorporated, with a capital of $25,000. Black River Falls, below Bessemer, is to be developed.

IONIA, MICH.—The Ionia & Owosso Railway Company has filed articles of incorporation with the Secretary of State, with a capital stock of $1,500,000, for the purpose of building an electric railway from Ionia to Owosso, a distance of about 45 miles. The directors of the company are: Gov. A. T. Bliss and C. H. Pomeroy, of Saginaw; ex-Gov. John T. Rich, J. L. Hudson, W. W. Steele and E. M. Hopkins, of Detroit; Frank Westcott, Vernon and F. S. Porter, of Lansing.

MINNEAPOLIS, MINN.—The Minneapolis & Rainy River Railway Company, capitalized at $1,000,000, with headquarters in Minneapolis, has filed incorporation papers. The line of the company is to extend from Minneapolis to a point on the Rainy River in Itasca County. From there a branch is to go northwest to the Big Fork River. The incorporators and officers of the company are William T. Joyce, Chicago, president; H. C. Akeley, Minneapolis, vice-president; Frank C. Dearhard, Minneapolis, general manager; Charles H. Hackley, Muskegon, Mich., and F. A. Bill, Minneapolis.

ST. LOUIS, MO.—The St. Louis Portland Cement Company and the Federal Roofing Tile Company have decided to construct an electric railway running from Baden to their plants at Prospect Hill, and from there to Spanish Lake. The line will run over private right of way.

ST. JOSEPH, MO.—The St. Joseph, Stanberry & Northern Railway has been organized with a capital stock of $400,000. The officers are George C. Sims, of Des Moines, president and treasurer; J. E. Patrick, of St. Joseph, vice-president; S. F. Moore, of Terre Haute, Ind., secretary; Mrs. Alice M. Butler, of St. Joseph, general manager.

LEWISTON, MONT.—The Citizens' Electric Company is engaged in making a survey for a 22-mile line to Kendal. The company, which sells current for lighting and power purposes, has not yet decided whether its railway undertaking shall be incorporated as a separate company or not. In any event, the Citizens' Company will furnish the power. The new equipment required will include 56-lb. rails, rotary converter, copper wire, etc. John L. Bright, of Lewiston, is president and treasurer of the Citizens' Electric Company.

JERSEY CITY, N. J.—The Public Service Corporation has purchased a 2½-mile tract of land on the Kearny meadows, over which a more direct electric railway route will be made between Newark and Jersey City. The company also proposes to erect its own bridge over the Hackensack.

HAMMONTON, N. J.—The construction of a trolley road between Hammonton and Vineland, a distance of 18 miles, is being agitated by the board of trade. Assemblyman Thomas C. Elvins, Assistant Postmaster Albert L. Jackson and Colonel Benjamin W. Richards have been appointed a special committee to investigate the feasibility of the road and report to the board.

SALEM, OHIO.—The Youngstown & Southern Railroad Company has decided to locate its power house at Lisbon.

TOLEDO, OHIO.—The Toledo Railways & Light Company has decided to erect an addition to its power house here.

OKLAHOMA CITY, OKLA.—The Oklahoma City, Lexington & Sulphur Springs Electric Railway Company has been chartered with a capital of $1,000,000.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company will build a line from Norristown to Pottstown.

BLOOMSBURG, PA.—The Denville & Bloomsburg Street Railway Company has given the contract for the building of the Grovania power plant to M. H. Rhoades, of this city.

NORRISTOWN, PA.—Notice has been filed in the Recorder's office of the intention of the Schuylkill Valley Traction Company to build an extension of the Trappe & Limerick Electric Railway from Saratoga to Pottstown, a distance of 5 miles.

TITUSVILLE, PA.—The Titusville Traction Company has obtained right of way for a new line through the oil region between Titusville and Rouseville. It is stated that the Titusville line is to be extended to Meadville, where it will connect with the line to Erie.

WASHINGTON, PA.—The Brownsville, Beallsville & Washington Street Railway Company has applied for a charter to build an electric railway from Brownsville to Washington over the historic National pike, with a branch road from Maiden north to California and Coal Center, which will also connect with the Pittsburg and Allenport line at Allenport and a branch from Beallsville south to Frederickstown and Millsboro. The entire length of the company's lines will be 50 miles. Pittsburg and Philadelphia capitalists will finance the project, and rights of way are now being secured.

GALVESTON, TEX.—It is reported that the Galveston City Railway Company will make extensions and improvements to its system.

SPOKANE, WASH.—A petition has been filed with the County Commissioners by Hon. S. J. Crutcher, A. J. Smith and A. H. Guston, asking for a franchise for an electric railway from the county line between Whitman and Spokane Counties to the city of Spokane. The proposed line is a part of the line projected from Colfax to Spokane, the franchise for which through Whitman County has already been granted.

ST. JOSEPH, ONT.—The St. Joseph & Stratford Electric Railway Company has obtained its charter, the survey has been completed, and the engineers are now completing their plans and estimates. The president of the company is T. G. Comsolles, Ottawa, and the secretary, O. Bissonnette, St. Joseph, Ont.

NEW INDUSTRIAL COMPANIES.

THE NEWBURGER ELECTRIC COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $10,000. The directors are Herman Devos, R. B. Banton and Banton Moore, of New York.

THE ELECTRIC HEATER COMPANY, of San Francisco, has been incorporated with a capital stock of $75,000 by A. C. Swalley, T. C. Maguire, et al. The place of business is San Francisco.

THE LIMA INSULATOR COMPANY, of Lima, N. Y., has been incorporated with a capital stock of $100,000. The incorporators are E. W. Lothrop, Boston, Mass.; D. H. Finucan, Lima, and A. M. Wellman, Friendship, N. Y.

THE MAGNETIC POWER COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are J. O. Stevens, Plainfield, N. J.; Albert Graham and A. J. Raymond, Brooklyn, N. Y.

THE YETMAN TRANSMITTING TYPEWRITER COMPANY, of Mineola, N. Y., has been incorporated with a capital stock of $250,000. The directors are C. L. Morse, G. R. Morse and C. L. Spier, all of New York.

THE STOCKBRIDGE ELECTRIC COMPANY, of Stockbridge, Mass., has been incorporated in New Jersey with a capital stock of $25,000. The officers are: President, R. B. Trowbridge, of New Haven; vice-president, Stephen D. Field, of Stockbridge, Mass.; secretary and treasurer, R. C. Stetson, of Stockbridge. The new company is to manufacture the electrical devices and inventions of Mr. S. D. Field.

LEGAL.

"TURN-DOWN" INCANDESCENT LAMPS.—The Phelps Company has brought suit against the Electric Appliance Company, Henry Newgard & Company and the Monarch Electric & Wire Company in Chicago, and Barton & Netting, Seidler Miner and the Miller Seldon Electric Company in Detroit, for alleged infringment of its leading patent, granted to W. J. Phelps, May 19, 1898. The Phelps Company claims that its patents issued and pending control every practical commercial form of baby filament "turn-down" lamp.

MARCONI WIRELESS.—Justice Fitzgerald, in the New York Supreme Court, has granted the application of the Marconi Wireless Telegraph Company of America to compel Franklin Bien, counsel for one Henry Gardner, to disclose the identity and address of his client, Henry Gardner. This "person" recently sued the Marconi Company for the appointment of a receiver, alleging that he was a stockholder of the company. The company said that it knew nothing about Henry Gardner, that he was not a stockholder of record and was in its opinion a myth.

TRACKLESS TROLLEY CHARTER REFUSED.—Attorney-General Carson, of Pennsylvania, has given an opinion to Governor Pennypacker on the status of trackless trolley companies, in which he advises against the granting of a charter to the Sayre Trackless Trolley Company, because the purpose for which the company sought a charter is not within the provisions of the acts of Assembly authorizing the granting of charters. An application for a charter was made by the company for the purpose of installing and operating a line of trackless cars and coaches, with electric power, to furnish transportation for the public in the boroughs of South Waverly, Sayre and Athens, in Bradford County. After discussing the acts of Assembly which provide for the granting of charters, and commenting on the language of the acts, the attorney-general says: "All existing companies are subject to restraint. This proposed new company would be without restraint. No statute applies to it. It is not a railroad, nor a railway, nor an omnibus line. If it were attempted to subject it to the restraint of existing statutes, it might be found that no statute in terms applied to it, and that no statute could be judicially stretched so as to cover it. Hence, a gigantic creature of the State's begetting would arise to roam at will, uncontrollable because beyond the reach of existing law."

TROLLEY-WHEEL PATENT DECISION.—The United States Circuit Court of Appeals for the Sixth Circuit, that of Cincinnati, has decided that the trolley wheel of the Star Brass Works, of Kalamazoo, is not an infringement of the Anderson patent No. 412,155, owned by the General Electric Company. The case was brought before the court on an appeal from the Circuit Court of the United States for the Western District of Michigan. The suit for infringement was on the eighth claim of the patent, which covered "the combination, with a trolley frame and trolley wheel, of metallic conducting brushes, g^2, between the hubs of the trolley wheel and the said frame, to operate substantially as described." The court construed this claim as requiring the springs to be located inside the harp. In the present form of trolley wheel manufactured by the Star Brass Works, and which is covered by a patent, No. 690,639, the spring is placed on the outside of the harp. Here it is protected against injury from without by being placed in a deep recess, and against injury from within by the intervening frame. The court held that "a patent for protecting a spring by locating it on the inside of the trolley harp is not infringed by placing it in a recess on the outside any more than a patent for protecting it by counter-sinking it on the oustide is infringed by locating it wholly on the inside. Although the result may be the same, the device is different, and the patent covers only the device." The judgment of the lower court was, therefore, reversed.

PERSONAL.

G. S. COVEY.

MR. G. S. COVEY.—Frequently there appear in the electrical and daily papers various accounts of the electrocution of persons by voltages ranging from 110 up to the maximum electromotive force of transmission circuits, but few indeed are the accounts of the survival of persons who have been in contact with pressures exceeding 2200 volts. So far as the records at hand show, previous to the time of the accident about to be described, the survivor of the most serious electric shock is a Mr. Crawford, who, by grounding a 33,000 volt line a few years ago in California, subjected his body to a difference of potential of 19,000 volts. Information has been received from the place of the accident giving a detailed account of the grounding through his body of one line of a 45,000-volt, three-phase transmission circuit, by the inspector of line and sub-stations, Mr. G. S. Covey at Bunker Hill mine, Warden, Ida., on November 9th, 1903. The neutral point of the star-connected, high-potential coils of the transformers is joined in the circulating pipes of the transformer. Standing on the transformer case when his head came in contact with the live primary circuit, it would seem that his body must have been subjected to 26,000 volts. That death was not instantaneous is remarkable. However, after the doctors had worked for six hours, consciousness was regained. The extent of his burns can be judged from the fact that while in the hospital skin grafting to the extent of about one square foot had to be done. Mr. Covey is at this writing in perfect health, having been able to

resume work four and one-half months after the accident. He still handles electric wires, but is not desirous of repeating his short-circuiting experiment.

DR. A. RAPS.—American friends of Prof. Dr. August Raps, of the Siemens & Halske Company, of Berlin, have news of his betrothal to Miss Else Gaertner, daughter of Mr. William Gaertner, of Burg Maus, near St. Goarshausen.

MR. WILBUR B. DRIVER, president of the Driver-Harris Wire Company, Harrison, N. J., has almost entirely recovered from his recent severe illness and expects to resume in the near future his duties also as the active selling representative of the company.

MR. B. F. KIERULFF, JR., manager of B. F. Kierulff, Jr., & Company, of San Francisco, Cal., was a recent visitor in New York. This firm is the Pacific Coast sales agent for a number of good electrical manufacturers, and Mr. Kierulff's trip east is in connection with that work.

DR. M. I. PUPIN is the subject of the portrait-biographical calendar issued by the Bullock Electric Mfg. Company for August. A concise account of his brilliant career is given, but an error is made as to the doctor's age. He is 46 not 44, although his picture makes him look 34, and is a good likeness.

MR. ALBERT SCHMID, technical director of the Westinghouse Electric interests in France, and manager of their Havre factory, has been recently visiting in this country with his wife. They spent a large part of their trip at St. Louis, and disappointed a great many friends who had hoped to see and entertain them.

MR. J. P. GREENWOOD, M. E., has moved his headquarters from Hattiesburg, Miss., to New Orleans, where he has opened an office in the Hibernia Building, Room 908. Mr. Greenwood is now acting as district manager for the Electric Machinery Company, of Minneapolis, and is also southern agent for the Reeves Engine Company, of Trenton, N. J.

PROF. W. A. ANTHONY.—We regret to note that Prof. Anthony, while riding his bicycle in New York City last week, had the misfortune to be run over by a heavy ice wagon. The consequences included a fracture of the hip bone, which will necessitate his lying in the Presbyterian Hospital, where he now is, for six or eight weeks. The professor is as usual optimistic, and like King George thankful it is no worse. He has the hearty sympathies and good wishes of a host of friends.

MR. J. H. HALLBERG, consulting engineer, 45 Broadway, New York City, has been retained in a consulting capacity by the Atlantic Mills, Providence, R. I., where extensive electrical developments are under way, requiring possibly an ultimate capacity of 4000-hp. The mill operates already something like 1000 arc lamps and several hundred horse-power of direct-current motors. A new boiler and steam plant now being erected includes a 600-hp Westinghouse steam turbine and two-phase, 440 volt, 60 cycle generator for motor current.

MR. WALTER C. McKINLOCK has been appointed district sales manager of the Philadelphia office of the Nernst Lamp Company, located at 1121 Walnut Street, and will have supervision of this entire territory, consisting of Eastern Pennsylvania, Maryland and the District of Columbia. Previous to his appointment, Mr. McKinlock, for the past two years, was the very successful representative of the Western Electric Company, Chicago and New York, for the territory comprising western Pennsylvania, West Virginia and Maryland, with sales offices in the Empire Building, Pittsburg, Pa. Among central station managers, superintendents and purchasing agents Mr. McKinlock is very popular and has many stanch friends who will be glad to hear of his new appointment.

Trade Notes.

CRESCENT COMPANY, Chicago, has issued a neat bulletin (No. 230) that tells all about Crescent lamp coloring and frosting. It will be glad to have all interested in incandescent lamps send for it.

JOSEPH H. THOMPSON, Jr., 11 Broadway, New York City, is issuing his new list of bargains in electrical and steam machinery. It comprises a wide range of apparatus upon which tempting prices will be made.

THE F. BISSELL COMPANY, 226 Huron St., Toledo, Ohio, say that during July they had a brisk movement in cable trolleys. It was at first difficult to supply the demand, but all orders are now being filled promptly.

THE ROCHESTER MACHINE TOOL WORKS have brought out a splendid illustration of the Acme engine with special bed plate for direct coupling to a dynamo. This illustration is shown on a blotter which the company issues, thus enabling the user to have a reminder of the engine before him.

GISHOLT MACHINE COMPANY, Madison, Wis., has issued a very neat and tasteful bulletin on its machine tools of latest type and design. It includes big-bore turret lathe, standard turret lathe, horizontal boring mill, vertical boring and turning mill, with and without turret head, universal tool grinder, etc.

UNITED TELPHERAGE COMPANY, 20 Broad Street, New York City, has issued Circular No. 50, relative to its portable electric and hand hoists, which at first merely a development of its regular telpherage system, have created a large demand on their own account as convenient, efficient and economical devices.

WEATHER-PROOF TELEPHONES.—The Conn. Tel. & Elec. Company, of Meriden, Conn., reports large sales on its weather-proof iron box telephone, which is especially designed for mine, street railway and police systems. The company will, on request, send its large new catalogue, which is profusely illustrated with telephone material.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that an unusually large number of central stations, as well as isolated plants, are waking up to the advantage of buying lamps on contract. The company says it has already "got busy" entering these contracts and making preparations to handle the fall demand for Packard lamps.

FEDERAL ELECTRIC COMPANY has issued a circular announcing the removal of its offices and factory to Girard, Pa., where modern facilities and additional shop equipment will enable it to increase its output greatly and facilitate the prompt and efficient handling of orders. It will be fully established this week in its new quarters.

THE WINONA TECHNICAL INSTITUTE, of Indianapolis, Ind., will open its trades school on Sept. 21 next. The school is established for the purpose of giving deserving boys training in habits of industry by teaching them mechanical trades. Special attention will be given to electrical work. Mr. Sol. C. Dickey, Indianapolis, Ind., is president.

ELECTRIC HEATING.—Mr. W. S. Hadaway, Jr., 136 Liberty Street, New York City, has just issued an interesting little circular called "A brief statement about electric heating," in which he reviews the recent developments and features of the subject and puts the situation in a persuasive argument. Mr. Hadaway has done some notable and original work of late years.

PEASE PUMPS.—Some little while ago the Pease motor-driven pumps for supplying office building tanks, hotels, residences, etc., were described in ELECTRICAL WORLD AND ENGINEER. These are now being placed on the market by Mr. Chas. S. Pease, 13 Dutch Street, New York, who has already received a large number of orders for these compact and convenient installations.

ARC LAMPS IN GERMANY.—The Sachsenwerk, Licht-und-Kraft-Aktiengesellschaft, Niedersedlitz-Dresden, Germany, announces that after being satisfied with the superior constructioon and quality of the arc lamps manufactured by the Anker-Elektrizitäts-Gesellschaft, of Leipzig, it has purchased the right to manufacture these lamps and has started their manufacture on a large scale.

WHY USE A CIRCUIT BREAKER?—This is the title of a handsome quarto pamphlet issued by the Cutter Company, of Philadelphia, and, as the sub-title explains, is a brief sketch of the reasons why a circuit breaker should be used and the "how" of its use, as well as the cost of it. The discussion of the subject is excellent and as a whole the pamphlet is most interesting and entertaining.

FRANK B. COOK, of 239 West Lake Street, Chicago, reports the recent shipment of more than two hundred pole cable terminals to the Pittsburg & Allegheny Telephone Company. One hundred more are nearly completed for shipment. The Pittsburg & Allegheny Telephone Company is using some of these terminals for its McKeesport Exchange, the balance being for some of its other exchanges.

THE STANDARD TRUCK AND FORGING COMPANY, 3101-11 North Broadway, St. Louis, Mo., has issued catalogue No. 1 describing railway truck and blacksmith supplies. This company is new in the field and has been fortunate in being able to place in direct charge in each of its departments men having had long experience in such work, so that proper workmanship, high quality, good finish and prompt service are insured.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, in catalogue No. 67A illustrates and describes a complete line of "Century" belt conveyors, which have met with much favor for handling ores, broken stone, sand, gravel, chemicals, boxes, bags, etc. Special pricelist No. 62B of the same company is devoted to Jeffrey water elevators of the chain bucket type and double-geared horse-powers for operating water elevators or similar duty.

THE ALBERGER CONDENSER COMPANY, 95 Liberty Street, New York City, in a pamphlet just issued illustrates various types of condensers, vacuums and circulating pumps which it has recently manufactured and installed in connection with steam turbines and reciprocating engines where high vacuum is a necessity. The company is prepared to contract for condensing apparatus for all kinds of service, and will furnish plans, drawings, specifications and estimates upon application.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is reporting a continual demand for its "lightning proof" bridging telephones and non-infringing, self-restoring, drop switchboard equipment for rural village exchanges and country party-line systems. It is believed that the demand will not be greatly affected by the usual presidential year lull, on account of a constantly growing demand for the high grade of equipment just having been introduced by the company.

A WORTHINGTON MAP.—The firm of Henry R. Worthington has published a small map showing the location of its old works in South Brooklyn, the offices in Manhattan and the new works at Harrison, N. J., with the intercommunicating lines of transportation. The old works were founded in 1840 and now cover about four and a half acres and employ 2000 men. The new plant occupies a 34-acre tract, has 18 acres of floor space and will accommodate 6000 workmen. It is the largest industrial plant so near New York and embraces the latest improvements in production engineering.

A JAPANESE ELECTRICAL ENGINEER.—The Japanese in Tokyo are not so busy celebrating victories that they have no time left for the arts of peace. The following message has lately been received by an American manufacturer of electric generators and motors: "Tokyo, Japan. Messrs. Crocker-Wheeler Company, Ampere, N. J., U. S. A. Gentlemen: I beg you please to send me a copy of your precious catalogue, which I have a great interest, as I shall commence some trifling business for the electrical engineering in after a few months, if you favor it for me I should be in great thankfulness. Very truly yours, ——— ———."

NATIONAL WIRE CORPORATION.—On and after August 1, 1904, the general and executive offices of the National Wire Corporation will be moved from New Haven and located in the Engineering Building, No. 114 Liberty Street, New York City, telephone No. 7620 Cortlandt. The corporation will continue, as in the past, to give all inquiries, orders and correspondence of every nature prompt personal attention, and with enlarged facilities and close attention in the manufacture of all standard and special wires, wire rope and other wire specialties required by the trade, expects to enjoy continued and larger patronage.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, has just issued an attractive new catalogue descriptive particularly of its Sunburst Prismo lamps. This type is designed for use where something between the arc and the ordinary incandescent lamp is required, and the company reports a good demand for these lamps and that they are giving excellent satisfaction. This type of lamp is made either with the Prismo glass reflector or the metal reflector and collar. The former, however, is the favorite. A copy of this catalogue can be procured by writing either direct to the manufacturer or to the Western Electric Company, Chicago, New York and other principal cities.

MACHINE TOOL DRIVE.—The Westinghouse Electric & Manufacturing Company has just issued a very interesting and handsome pamphlet of 42 pages on the subject of machine tool drive. The topic is discussed in an able and interesting manner and the various economies and advantages of motors as compared with belts are brought out, curved and tabulated. The first part of the pamphlet is devoted to a general treatment of the subject, and the second part considers it under the various heads of the alternating current system, direct current system, multivoltage and three-wire balanced voltage. The pamphlet is not only beautifully printed, but elaborately illustrated, a large number of tools being shown in association with Westinghouse motors. The cuts number some 40, and excepting the curves and diagrams, are all of them exemplifications of actual work.

JOHNSON & PHILLIPS, Old Charlton, Kent, England, have now completed the recent extensions to their cable department. The new shops include the very latest equipment for the manufacture of dry core telephone cables, and they are at present engaged on an order for the General Post Office, amounting to some 730 miles. The whole of the new machinery is of their own design and manufacture, as also are all the motors and electric power plant used in the factory, and it is satisfactory to know that this latest system of driving shows a considerable saving over the former method of using separate steam engines. A construction and cable-laying department has now been organized, and is fully employed on Admiralty contracts for the Portsmouth & Pembroke Dockyards, as well as cable-laying at Handsworth, Weymouth, Birkenhead and Ipswich extensions. We understand that at the end of the present financial year the firm proposes opening up a vulcanized bitumen shop and laying down certain wire-drawing plants for drawing their own copper wire.

A SUBSTITUTE FOR PLATINUM.—Bulletins just issued by Vereinigte Fabriken für Laboratoriumsbedarf, of Berlin, describe a new heating substance called "Kryptol," suitable for electric furnaces and other heating apparatus. The substance is a granulated resistance material which, when inserted in an electric circuit, will be heated and will produce any temperature up to 2500° C. In applying the heating material, it is spread out on clay or enamel plates, the layers varying in thickness according to the current to be applied and the temperature desired. By unequal distribution of the material, it is possible to obtain different temperatures at different parts of the surface. "Kryptol" is intended as a substitute for and an improvement upon the metallic heating wires used in electric furnaces, since, by its use, there can be attained temperatures which cannot even be approximately reached by means of metallic resistance, while the new substance is in no way influenced by acid vapors. A small catalogue of the same concern gives in detail a list of about 1000 pieces of chemical apparatus, etc., manufactured by it and now exhibited in the Educational Laboratory of the German Government, Dept. of Education, at the World's Fair, St. Louis. The New York office is at 20-24 East 12th Street, with the Laboratory & School Supply Company.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 26, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

765,686. ELECTRICALLY CONTROLLED DAMPER FOR HEATERS; Frank J. Sprague, Oswego, N. Y. App. filed Sept. 4, 1903. Consists of mechanism for closing and breaking an electric circuit which operates to set in motion a spring motor to open or close a damper or valve to the passage of a fluid.

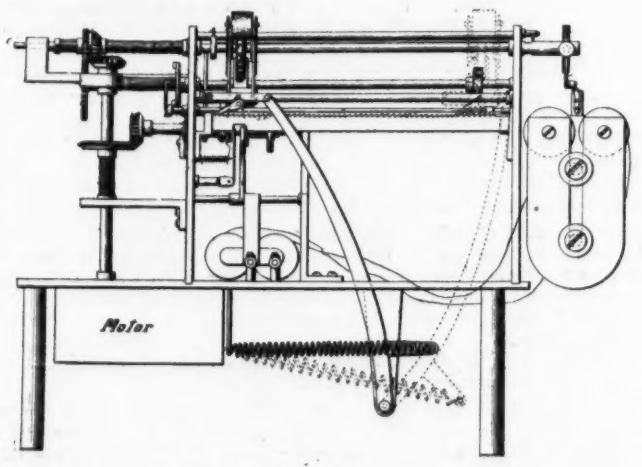
765,690. APPARATUS FOR PRODUCING GYRATORY MAGNETIC LINES OF FORCE FOR THERAPEUTIC PURPOSES; Reinhold Trub, Hombrechtikon, Switzerland. App. filed Sept. 12, 1902. Consists of an electro-magnet excited by direct or alternating current and adapted to be rotated on its axis adjacent to a soft iron body to produce "sinuous" lines for force.

765,765. AUTOMATIC FIRE-EXTINGUISHER; Joseph Butcher, New York, N. Y. App. filed Nov. 15, 1901. (See Current News and Notes.)

765,768. AUXILIARY APPARATUS FOR TELEPHONE SYSTEMS; William W. Dean, Chicago, Ill. App. filed Oct. 17, 1903.

765,773. ELECTRIC PRINTING MACHINE; George S. Gallagher, New York, N. Y. App. filed Sept. 18, 1903. Improvements on former applications.

765,822. TELEPHONE EXCHANGE SYSTEM; John P. Downs, Cleveland, Ohio. App. filed Oct. 23, 1902.



765,978.—Receiving Telegraph Printer.

765,850. TROLLEY; Walter O. Miller, Louisville, Ky. App. filed Feb. 10, 1903. The wheel is supported in the head which is in turn pivotally mounted in the pole, the axis of the wheel support being transverse to the axis of the wheel.

765,852. TROLLEY; Jacob M. Olinger, Vienna Crossroads, Ohio. App. filed May 12, 1904. Relates particularly to the mounting and centering of the wheel upon its journal pin.

765,887. OTOSCOPE; Peter T. Geyerman, Brewster, Minn. App. filed Feb. 4, 1904. A surgical instrument for inspecting and treating interior surfaces, consisting of a cylinder having a focusing tube at one end and a speculum at the other and a lamp within the speculum.

765,889. SHUNT; Jesse Harris, Rensselaer, N. Y. App. filed Jan. 25, 1904. Current bearing wires are attached to terminals between which is a thin metallic plate arranged to form several layers.

765,904. SYSTEM OF HOUSE WIRING; Joseph W. A. Richardson, New Orleans, La. App. filed March 14, 1904. Conduit strips are provided with separated passages or grooves arranged to receive the wires, positive wires in one groove and negative in another. Distributing boxes are located on the back of the strips.

765,917. HANGER FOR OVERHEAD CONDUCTORS; Sidney H. Cochran and Austin E. Anderson, Lynchburg, Va. App. filed March 24, 1904. Provides for a straight underrun for the trolley wheel and prevents sliding movement of the wire in the hanger.

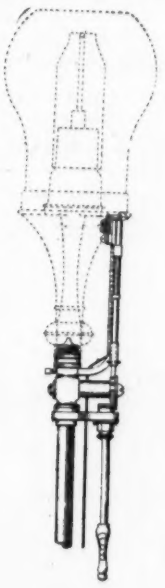
765,922. ELECTRIC SIGNAL SYSTEM; Joseph H. Harrell, Charlotte, N. C. App. filed Sept. 30, 1903. (See Current News and Notes.)

765,926. ELECTRICAL TOY; John Kelly, Paterson, N. J. App. filed May 4, 1904. Comprises a concealed battery and an induction coil and two contact points on an insulating finger ring—the arrangement being such as to give a shock to another person on shaking hands.

765,948. CURRENT-REGULATOR; James J. Wood, Fort Wayne, Ind. App. filed Aug. 17, 1903. (See Current News and Notes.)

765,974. TROLLEY WIRE CLIP; Albert E. Holaday, New Haven, Conn. App. filed Dec. 30, 1903. A compression clip made in halves, each half having a gripping plough for the trolley wire and devices for locking the halves together when in place.

765,978. RECEIVING INSTRUMENT FOR PRINTING TELEGRAPH



766,005.—Ignition Device for Mantles.

SYSTEMS; William R. Landfear, New York, N. Y. App. filed Sept. 17, 1903. Provides for moving the printing wheel step by step along its shaft and swinging the platen toward the same to effect the printing.

766,005. IGNITING DEVICE FOR INCANDESCENT MANTLE BURNERS; Henry C. Thomson, Boston, Mass. App. filed Nov. 6, 1902. Provides for the lighting of a main burner by an auxiliary burner, the latter being lighted by electrical devices.

766,047. SWITCH; Harry A. Lewis, Norristown, and William J. Casckey, Philadelphia, Pa. App. filed Nov. 27, 1903. Details of a "flush" switch aiming at simplicity of construction.

766,071. ELECTRICAL QUICK-RETURN SYSTEM; Richard H. Stevens and Samuel S. Wales, Munhall, Pa. App. filed Jan. 2, 1903. (See Current News and Notes.)

766,078. SECONDARY BATTERY; Otto Heinrich Friedrich Carl Walter, Berlin, Germany. App. filed Dec. 1, 1903.

766,104. SYSTEM OF MOTOR CONTROL; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 19, 1904. (See Current News and Notes.)

766,155. TELEPHONE-REPEATER; David H. Wilson, Chicago, Ill. App. filed Aug. 13, 1903.

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POSITION WANTED.—As traveling salesman for good electrical firm, either supplies, generators or lamps; several years' experience as central station manager and contractor; state terms and salary. Address No. 1574, care Electrical World and Engineer, New York.

POSITION WANTED.—By a young man in electrical work with chance of advancement; am a student of International Correspondence Schools, Scranton, Pa.; familiar with dynamo and engine running; best of references as to character. Address No. 1565, care Electrical World and Engineer, New York.

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POSITION WANTED.—By a well trained technical and business man, 25 years old; five years' experience in various branches of electric light and power work, designing, selling and contracting; especially familiar with circuit breakers and meters. Address No. 1578, care Electrical World and Engineer, New York.

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WANTED.—A first-class, up-to-date, energetic man, capable of taking foremanship in repair shop; must be familiar with all branches of armature and field windings and machine work in connection with electrical repair work in general; only those qualified to fill the above position need reply. Address, stating full particulars, Graham Brothers, 662 Hudson St., N. Y. City.

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	Lt.	
2	300	Westinghouse, 15-K.W.
1	500	Wood, 25-K.W.
1	900	West., 45-K.W., 2 phase.
2	1200	West., 60-K.W.
1	1500	Warren-Medberry, 75-K.W.
1	1500	West., 75-K.W.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Wood, 75-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
2	3000	Warren, 150-K.W.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES

	Lt.	
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	900	Warren-Medberry, 45-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1500	Stanley, inductor, 75-K.W.
1	2400	Gen. Elec., 120-K.W., A 120.
2	2400	Gen. Elec., 120-K.W., A.S.120.
2	3000	Stanley inductor, 150-K.W.
1	4000	Westinghouse, 240-K.W.

110 TO 125 VOLT GENERATORS (COMPOUND.)

DIRECT CURRENT.

	Lt.	
2	35	Hobart, Multipolar.
1	45	Lundell.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
2	50	Northern, Multipolar.
1	50	Westinghouse, Multipolar.
2	60	Hobart, Multipolar.
1	80	Fort Wayne, Multipolar.
1	80	Crocker-Wheeler.
1	80	Riker, Multipolar.
1	80	Perrett, Multipolar.
1	100	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Edison.
1	150	Eddy, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	160	Triumph, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	300	Phoenix, Multipolar.
1	300	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	300	Gen. Electric, Multipolar.
1	300	Western Elec., Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Edison, 25-K.W.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
1	540	Edison, 30-K.W.
1	540	C. & C. 30-K.W.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine.
2	700	Commercial, Multipolar.
1	700	Card, Multipolar.
1	700	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine.
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
1	2200	Western Electric, Multipolar, 125-K.W., 6 pole.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

220 TO 250 VOLTS COMPOUND GENERATORS.

	K.W.	
1	7½	Holtzer-Cabot.
1	9	New England, Multipolar.
2	10	T.-H.
1	12	Western Elec., Multipolar.
1	17½	Kester.
1	17½	Eddy.
1	20	Western Electric.
1	20	Keystone, Multipolar.
1	20	Eddy, Multipolar.
2	20	Western Elec., Multipolar.
2	30	C. & C.
1	40	C. & C., Multipolar.
1	40	Eddy, Multipolar.
1	45	Edison.
1	45	Am. Engine Co., Multipolar.
1	45	Western Elec., Multipolar.
1	45	C. & C., Multipolar.
1	45	Gen. Elec., Multipolar.
1	50	C. & C.
1	50	Commercial, Multipolar.
1	50	Maine, Multipolar.
1	55	Fuller, Multipolar.
1	55	Eddy, Multipolar.
1	60	Northern, Multipolar.
1	75	Siemens & Halske, Churchward type, Multipolar, direct connected to 14x14 Ideal engine.
1	80	C. & C.
1	100	Commercial, Multipolar.
1	125	Eddy, Multipolar.
1	150	National, Multipolar.
1	200	Eddy, Multipolar.
1	200	Westinghouse, Multipolar.
1	250	Western Elec., 6 pole.
1	300	Western Elec., Multipolar

500 TO 550 VOLT COMPOUND GENERATORS.

	K.W.	
1	60	Edison.
1	62	T-H.
1	75	Akron, 6 pole.
2	75	General Electric.
1	100	Siemens & Halske, 4 pole.
2	100	Edison.
1	100	Gen. Elec.
2	120	Westinghouse.
1	200	Thompson-Ryan.
1	200	General Electric.

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DIRECT CONNECTED UNITS

Dynamo	Engine	
50-K.W.	220 V.	American Ball.
42-K.W.	220 V.	Westinghouse, Alfrey.
30-K.W.	500	Gen. Elec. Arm. Sims.
50-K.W.	110 V.	Eddy, Ames.
37-K.W.	110 V.	West., Erie Ball.
30-K.W.	110 V.	Westinghouse, Ames.
8-K.W.	110 V.	Crocker-Wheeler, Case.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

45-K.W. General Electric.
25-K.W. Crocker-Wheeler.
15-K.W. Eddy, M. P.
7½-H.P. Gen. Elec., Type C E.
5-H.P. Gen. Elec. Type C E.
3-H.P. Gen. Elec. Type C E.
2-K.W. Westinghouse.
1-H.P. C. & C.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

150-K.W. Westinghouse.
75-K.W. Westinghouse.
55-K.W. Gen. Elec., M. P.
45-K.W. Edison.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. Sprague.
7½-H.P. Edison.
5-H.P. Diehl.
2-H.P. Diehl.

500 VOLTS DIRECT CURRENT

75-K.W. Westinghouse, M. P.
15-H.P. Westinghouse, M. P.
1-H.P. Westinghouse, M. P.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

40-H.P. Type C Westinghouse.
30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
3-H.P. Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.

2 Phase, 440 Volts, 60 Cycles

100-H.P. Westinghouse.
40-H.P. Westinghouse.
30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Gen. Elec., 220 v.
5-H.P. Gen. Elec., 110 v.
3-H.P. Westinghouse, 110 or 220 v.
2-H.P. Gen. Elec., 220 v.
2-H.P. Westinghouse, 220 v. or 110 v.

1 Phase, 60 Cycles

5-H.P. Wagner.
3-H.P. Wagner.
1-H.P. Wagner.
½-H.P. Wagner.
½-H.P. Gen. Elec.

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Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

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ARC DYNANOS.

	Lt.	C.P.	
1	35	2000	T.-H., L D 2 ball.
1	50	1200	T.-H., L D 12, new ball.
2	50	2000	T.-H., M. D 2, 8-0., ring.
1	75	1200	T.-H., M D 12 8-0.
1	75	1200	Wood.
1	125	1200	Excelsior.

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.
1	1	General Electric, type I B.
1	2	Lundell.
1	2½	Riker.
1	3	C. & C.
1	3	Bernard, Multipolar.
1	3	Gibbs, Multipolar.
1	3	Lundell.
3	3	Western Electric, Multipolar.
3	3	Westinghouse, Multipolar.
1	3½	Eddy, Multipolar.
1	4	Commercial, Multipolar.
2	5	Gibbs, Multipolar.
3	5	Hobart, Multipolar.
5	5	Western Electric, Multipolar.
1	5	Eddy, Multipolar.
3	5	Belknap, Multipolar.
2	5	Crocker-Wheeler special printing press motors, direct con.
1	6½	Jenney, Multipolar, back geared.
1	7½	Edison.
2	7½	Western Electric, Multipolar.
1	7½	Milwaukee, Multipolar, series.
1	8	Holtzer-Cabot.
1	8	Crocker-Wheeler, series.
1	8	Maine, Multipolar.
1	10	Standard, Multipolar.
1	10	C. & C., Multipolar.
1	10	Keystone, Multipolar.
1	10	Western Electric, Multipolar.
2	10	Westinghouse, Multipolar.
3	10	Bernard, Multipolar.
1	15	Keystone, Multipolar.
1	15	New England, Multipolar.
1	15	Western Electric, Multipolar.
1	18	Edison, 15-K.W.
1	20	Eddy.
1	20	Kester.
2	25	Edison.
1	25	Western Electric.
1	25	Keystone, Multipolar.
1	25	Eddy, Multipolar.
1	25	Western Electric, Multipolar.
2	40	C. & C.
1	40	Sprague-Lundell, Multipolar.
1	50	C. & C., Multipolar.

	H.P.	
1	50	Eddy, Multipolar.
1	50	Am. Engine Co., Multipolar.
1	60	C. & C.
1	60	Edison.
1	60	Commercial, Multipolar.
1	60	C. & C., Multipolar.
1	60	Maine, Multipolar.
1	60	Western Electric, Multipolar.
1	60	General Electric, Multipolar.
1	65	Eddy, Multipolar.
1	70	Fuller, Multipolar.
1	75	Northern, Multipolar.
1	85	Western Electric.
1	100	C. & C.
1	125	Edison.
1	135	Commercial, Multipolar.
1	150	Eddy, Multipolar.
2	200	National, Multipolar.

500 TO 550 VOLT MOTORS.

	H.P.	
1	1	General Electric.
2	1½	Northern, series.
2	1½	Crocker-Wheeler.
1	2½	New England.
1	3	C. & C.
1	3	General Electric.
1	3	Jenney, Multipolar.
1	3½	Westinghouse, Multipolar.
1	4	Edison.
1	4	Bernard, Multipolar.
1	5	Fort Wayne.
2	5	Triumph, Multipolar.
3	5	Crocker-Wheeler.
1	6	C. & C., enclosed.
1	7½	Card, Multipolar.
1	7½	Jenney, Multipolar.

	H.P.	
1	7½	C. & C., Multipolar.
3	7½	Crocker-Wheeler.
1	7½	Eddy, Multipolar.
1	10	Phoenix, Multipolar.
1	10	Crocker-Wheeler.
1	10	Northern, Multipolar.
1	10	Triumph, Multipolar.
2	10	General Elec., Multipolar.
1	10	Perrett, Multipolar.
1	10	Eddy, Multipolar.
3	10	Belknap, Multipolar.
1	12	Am. Engine Co., Multipolar.
1	15	Eddy.
1	15	C. & C.
1	15	Edison.
1	15	Perrett, Multipolar.
1	15	Maine, Multipolar.
1	20	Eddy.
1	20	Perrett, Multipolar.
1	20	Holtzer-Cabot, Multipolar, enclosed.

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.	
2	⅓	Stanley, 110 volts.
1	½	Holtzer-Cabot, 104 volts.
1	½	Emerson, 104 volts.
1	½	Wagner, 104 volts, automatic.
1	1	Fort Wayne, 104 volts.
1	1	Wagner, 208 volts, automatic.
1	1½	Wagner, 208 volts, automatic.
1	3½	Wagner, 110 volts, automatic.

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For Monocyclic System.

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	H.P.	
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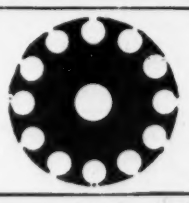
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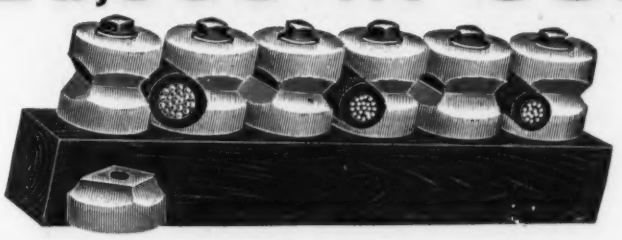

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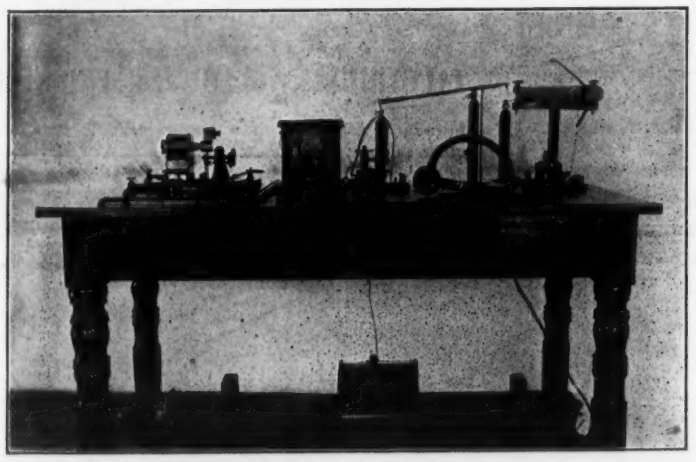

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